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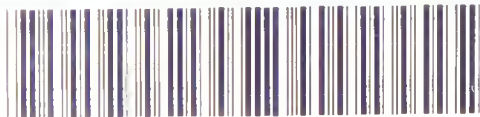
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A MANUAL OF SURGICAL TREATMENT

A Manual of Surgical Treatment

BY

W. WATSON CHEYNE, C.B., M.B., F.R.C.S., F.R.S.

Professor of Clinical Surgery in King's College, London, etc.

AND

F. F. BURGHARD, M.D. AND M.S.(LOND.), F.R.C.S.

Teacher of Operative Surgery in King's College, London, etc.

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LONDON AND BOMBAY

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In Six Parts

PART VI.

SECTION II.

The Treatment of the Surgical Affections of the Rectum, the Liver, Pancreas and Spleen, the Genito-Urinary Organs, the Breast and the Thorax.

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To
THE RIGHT HON.
LORD LISTER, LL.D., P.R.S.,
THE FOUNDER OF MODERN SURGERY,
WITHOUT WHOSE WORK MUCH OF
THIS BOOK COULD NOT HAVE
BEEN WRITTEN.

AUTHORS' PREFACE.

GENERAL PREFACE.

THE subject of Surgery has now become so extensive that any work attempting to deal with it in an exhaustive manner must necessarily be so large and unwieldy as to be suitable only for purposes of reference, or for the use of those who devote themselves exclusively to its practice. In any text-book of convenient size the information given in certain branches of the subject must therefore be considerably condensed, and, as the first essential for the beginner is to have the fullest knowledge of the nature and characters of the diseases that he has to study, special stress is usually laid upon pathology, symptomatology, and diagnosis. For the practitioner, on the other hand, who is already acquainted with these points, the great essential is full and detailed information as to the best methods of treatment.

We have ourselves frequently experienced the want of detailed information, especially as regards the after-treatment of our cases, and have had to learn the best methods of procedure from experience. Nothing can of course replace experience, but it is often of the greatest advantage to have a detailed record of that of others upon which to base one's work. It is this want that the present work is intended to supply. We have tried to put ourselves in the place of those who have to treat a given case for the first time, and we have endeavoured to supply them with details as to treatment from the commencement to the termination of the illness. We have assumed that the reader is familiar with the nature and diagnosis of the disease, and we only refer to the pathology and symptoms in so far as it is necessary to render intelligible the principles on which the treatment is based, and the various stages of the disease to which each particular method is applicable.

We have purposely avoided attempting to give anything like a complete summary of the various methods of treatment that have from time to time been proposed: to do so would merely confuse the reader. Only those plans are described which our experience has led us to believe are the best, but with regard to these we have endeavoured to state exactly and in detail what we ourselves should do under given circumstances. In some cases no doubt several methods of treatment are of equal value, and while we have only discussed at length that which we have ourselves been led to adopt, we have referred shortly to the others.

We have not mentioned all the exceptional conditions that may be met with, but we have endeavoured to include all the circumstances with which the surgeon is most commonly called upon to deal. The task has been one of some difficulty, the more so as we have had, to a certain extent, to break new ground. This must serve as our excuse for the many shortcomings in the work.

PREFACE TO PART VI.—SECTION II.

THIS volume brings the work to an end, and its size will be a sufficient explanation of the delay in its issue. The success of the previous volumes has shown us that the book supplies a want; we have felt, therefore, that it would not be in any way advantageous to attempt to shorten this volume or hurry its issue.

In writing the portion of the book devoted to the surgical affections of the Kidney and Ureter, we have derived great assistance from Mr. Henry Morris's exhaustive work upon the subject; and we are further indebted to him and to Messrs. Cassell & Co. for leave to reproduce several drawings, which will be found duly acknowledged in the text. Another work of which we have made free use is Fowler & Godlee's well-known book upon Diseases of the Chest.

To M. G. Steinheil of Paris we are indebted for leave to reproduce several illustrations from Quénu & Hartmann's work, *Chirurgie du Rectum*, and to Messrs. Lippincott of Philadelphia for the drawings illustrating Dr. Bevan's article upon the "Surgical Anatomy of the Bile-ducts" in the *Annals of Surgery*.

Messrs. Down Bros. have again furnished the blocks of surgical instruments, as they have done in all the previous volumes, and to them our best thanks are due. All the remaining illustrations have been drawn from original sketches, and we offer our heartiest thanks to Mr. T. P. Collings upon the completion of his task. The indices to the book, as well as all the type-writing of the manuscript, are the work of Miss Grace Hill, and we are very grateful to her for the care that she has taken and for the excellence of the work she has done.

LONDON, *April*, 1903.

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DIVISION I.

THE SURGICAL AFFECTIONS OF THE RECTUM AND ANUS.

CHAPTER I.

ANATOMY OF THE RECTUM AND ANUS: METHODS OF EXAMINATION.

ANATOMY.

THE rectum proper extends from the lower edge of the third piece of the sacrum to the anus, and is about five inches long. The "first part of the rectum," formerly described in anatomical text-books, possesses a meso-colon and is indistinguishable from the sigmoid flexure, of which it anatomically forms a part.

The rectum thus defined may be divided into two portions, the rectum proper and the anal portion; the former is three to four inches long, lies in the hollow of the sacrum with its concavity forwards, and extends from the third piece of that bone to the apex of the prostate in the middle line. Below it has in front of it the trigone of the bladder, the vesiculæ seminales and the prostate in the male—with which it is in fairly intimate connection—whilst in the female the vagina and the cervix uteri are in relation with its anterior surface. Its lower extremity is supported by the levatores ani and the recto-vesical fascia. The peritoneum invests the lower part of the sigmoid flexure (the part formerly called the "first part of the rectum") completely, but about five inches from the anus the peritoneum only covers the anterior and lateral surfaces of the gut. The lateral investment then disappears, the anterior one however extending down to within three to three and a half inches of the anus and forming the posterior wall of the recto-vesical pouch. This part of the rectum may therefore be divided into two portions, the upper

one being partially invested by peritoneum, while the lower one runs from the inferior limit of the peritoneal investment to the insertion of the levatores ani (see Fig. 1).

The anal portion is about an inch and a half long and curves backwards, being limited above by the attachment of the levatores ani and below by the

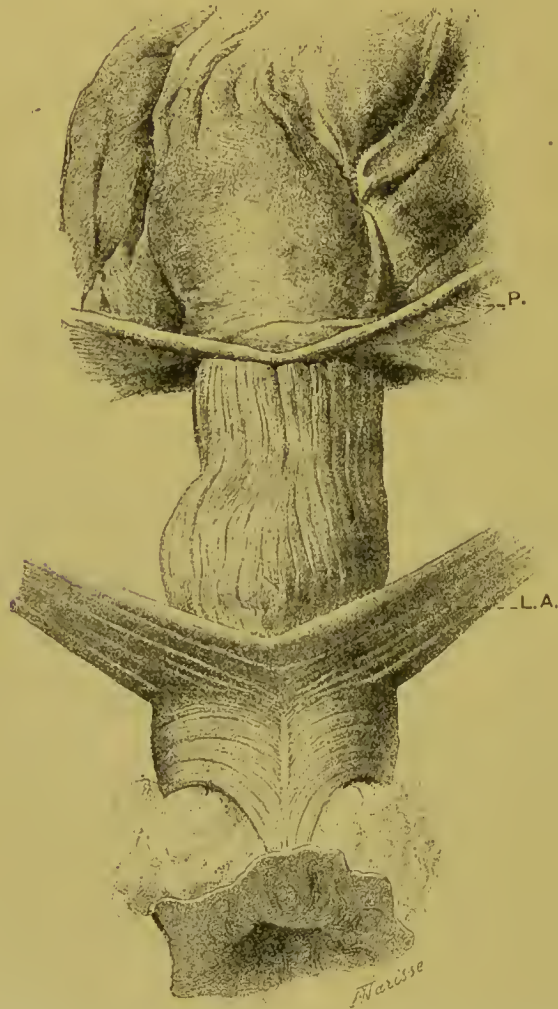


FIG. 1.—A DISSECTION OF THE RECTUM SHOWING THE ARRANGEMENT OF THE PERITONEUM AND THE LEVATOR ANI. This shows the rectum really divided into three portions, the upper one partially invested by peritoneum, the middle one quite devoid of any peritoneal investment, and the lower one extending from the insertion of the Levatores ani to the anal orifice.

P. Peritoneum. L.A. Insertion of the Levatores Ani.

(Quénu and Hartmann.)

external sphincter. It is not in relation to the peritoneum, and its upper third is embraced by the internal sphincter (see Fig. 1).

The rectal mucous membrane is thrown into a series of folds, the most important of which are known as Houston's folds arranged transversely to the long axis of the bowel. The lowest projects from the left-hand wall of the rectum opposite the prostate; the middle one projects from the

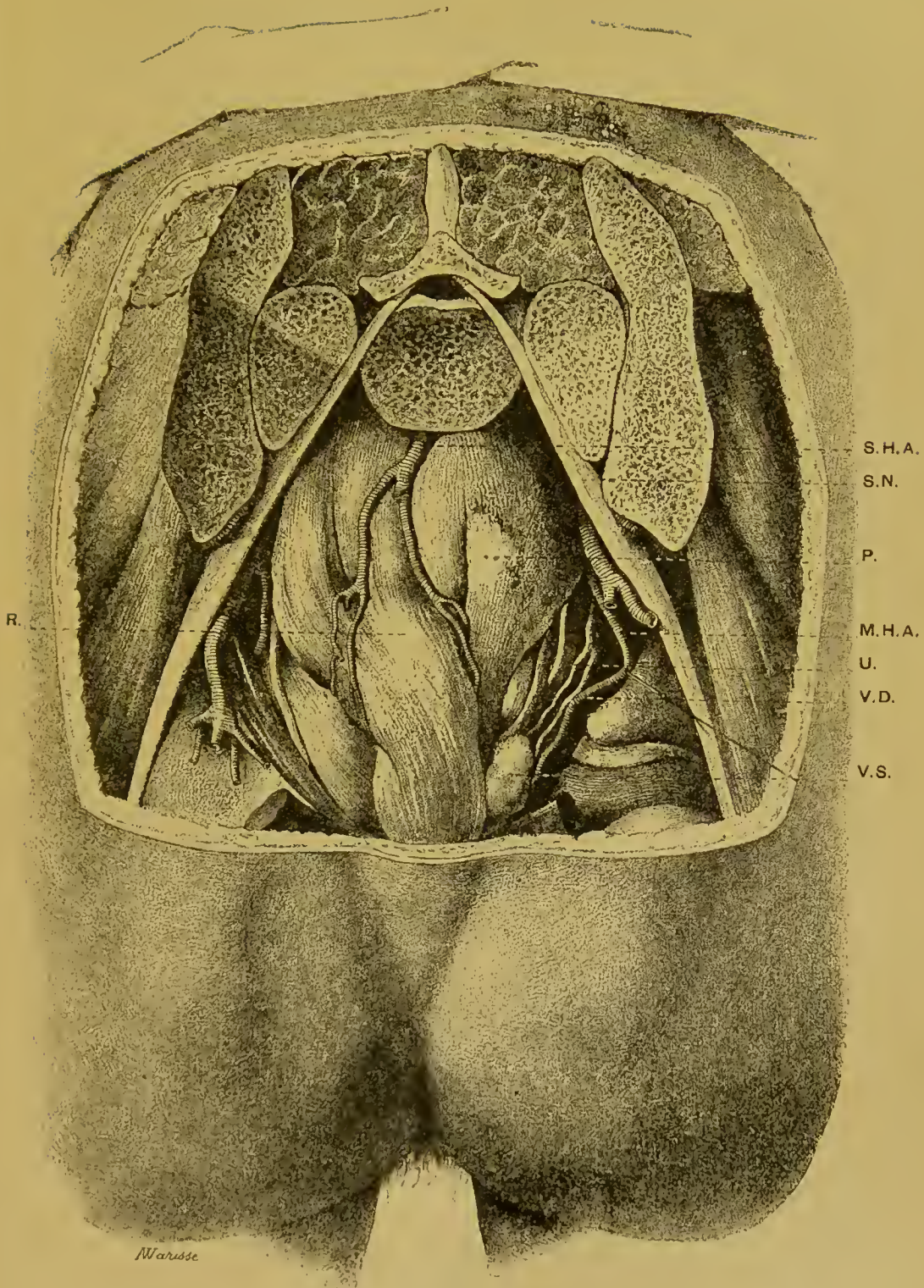


FIG. 2.—THE BLOOD-SUPPLY OF THE RECTUM. The sacrum has been removed; the subject is a male.

R. Rectum.
 S.H.A. Superior Hæmorrhoidal Artery.
 V.S. Right Vesicula Seminalis.
 U. Right Ureter.

P. Peritoneum.
 M.H.A. Middle Hæmorrhoidal Artery.
 V.D. Right Vas Deferens.
 S.N. Right Sciatic Nerve.

(Quenu and Hartmann.)

right-hand wall about 3 to $3\frac{1}{2}$ inches above the anus, whilst the upper one projects from the left-hand wall near the commencement of the rectum. When the bowel is empty these folds stand out about half an inch from the rectal wall and overlap one another, and they thus serve to keep the pressure of the rectal contents off the sphincter; they also act as an obstacle to the passage of a rectal tube.

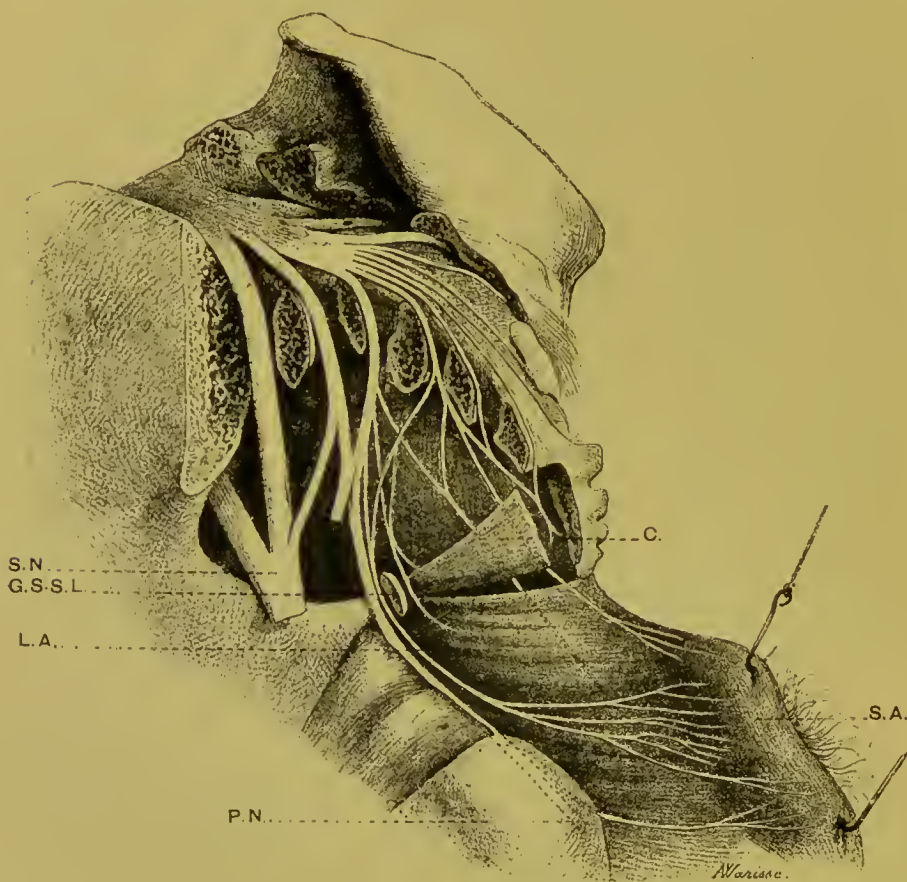


FIG. 3.—THE NERVE-SUPPLY OF THE RECTUM AND ANUS. The dissection shows the nerve-supply to the sphincters and how it will be affected by such operations as Kraske's.

S.N. Great Sciatic Nerve.

L.A. Levator Ani.

C. Coccygeus Muscle.

G.S.S.L. Great Sciatic Ligament.

S.A. Sphincter Ani.

(Quenu and Hartmann.)

There are also longitudinal folds (the columns of Morgagni), prolonged upwards from the radiating folds about the anus, which are united at their lower ends by small valvular folds of mucous membrane and serve to prevent the escape of the liquid contents of the bowel. It is amongst these folds that a fissure of the anus usually occurs.

The arterial supply of the rectum is derived partly from the mesenteric and partly from the internal iliac vessels (see Fig. 2). The entire upper part is supplied by the superior hæmorrhoidal branch of the inferior mesenteric artery, the mucous membrane of the middle part is supplied by the same vessel while the rest is supplied by the middle hæmorrhoidal

of the internal iliac ; the lower part is supplied by the inferior hæmorrhoidal branch of the internal pudic. These vessels perforate the muscular coats and run down vertically to the anus in the sub-mucous tissue, anastomosing freely with one another by cross branches.

The veins about the anus form the hæmorrhoidal plexus and run vertically upwards, passing through slits in the muscular walls ; they are without valves, and therefore the circulation in them is readily interfered with by distension of the bowel. The lower veins join the systemic circulation ; the upper ones empty into the inferior mesenteric vein, and thence into the portal circulation. There is free communication between the two sets, so that an obstruction to the hepatic circulation may give rise to distension of the plexus, and consequently to hæmorrhoids. The arrangement of the vessels above described is more particularly marked in the lower four inches of the bowel.

The lymphatic vessels of the rectum proper pass into the internal iliac group in the lateral wall of the pelvis. From the sigmoid-flexure they run to the glands in front of the sacrum between the layers of the meso-rectum.

The nerve-supply is from the pelvic plexus of the sympathetic, and this is reinforced by branches of the second, third, and fourth sacral nerves (see Fig. 3), the supply from the last-named being most abundant.

EXAMINATION OF THE RECTUM.

The physical examination of the rectum may be effected either by palpation or by inspection.

Inspection of the external parts is effected by separating the folds of the anus and making the patient strain while he bends well over the back of a chair, the knees being kept extended ; hæmorrhoids, a polypus, a prolapse, or a fissure of the anus are thus often easily detected.

By means of **digital examination of the rectum** nearly the whole of the rectum proper may be investigated, according to the position of the patient. Unless the rectal affection be a very painful one, an anæsthetic should not be used, at any rate at first, and the patient should lie on the left side rather than over on the face, and should have the knees well drawn up ; in other words, he should assume the ordinary left lateral gynæcological position. Previous to the examination the rectum should, if possible, be emptied by a purge administered overnight, and it is also well to wash it out thoroughly with an enema just before the examination is undertaken. The index finger, thoroughly lubricated, and with soap pressed well down into the cracks and folds about the nails so as to facilitate disinfection afterwards, is insinuated through the anal orifice, and as much of the rectum is palpated as is within reach. If the patient now be made to stand up or to strain somewhat, or if the surgeon compress the abdomen forcibly, an additional inch or so of the rectum can be brought down within reach of the finger. Any examination with a bougie is untrustworthy and not worth attempting.

To examine the rectum higher up, however, it is well to administer an anæsthetic and to dilate the anal orifice fully. This is done by means of the fingers which gradually stretch the muscular fibres without rupturing them (see Fig. 4). The two forefingers are first introduced into the anus and are gradually and firmly separated and at the same time swept round and round the lower end of the bowel. When a little dilatation has been effected, three fingers may be inserted on each side and hooked well above the internal sphincter. They are then gradually separated until they touch the tuber ischii on each side. After this it will be found that two or three



FIG. 4.—FORCIBLE DILATATION OF THE SPHINCTER ANI. The dilatation figured above is that employed as a preliminary to operative procedures in which it is important that the sphincters should be stretched to their utmost limit. For less vigorous dilatation the thumbs may be substituted for the fingers.

fingers can be readily introduced into the rectum and also specula of sufficient size. Examination by the hand insinuated into the rectum, although much recommended at one time, is unsatisfactory. It is apt to produce undue distension and even tearing of the tissues, while the fingers are cramped and can really gain very little information.

To complete the examination of the rectum, proper **specula** should be used, of which the best are those devised by Kelly of Baltimore. The lower part of the rectum is best seen with the patient in an exaggerated lithotomy position; for examination of the upper part the knee-chest position must be employed, and in both instances full anæsthesia is advisable. The speculum for the lower part of the rectum—or “short procto-

scope"—is a cylinder, $5\frac{1}{2}$ inches long, with a blunt obturator (see Fig. 5), which is introduced within the anus for about two inches; then the obturator is withdrawn, air passes in and expands the lower part of the bowel, and at least the whole of the lower two inches of the mucous membrane of the rectum may be inspected as the speculum is gently withdrawn. The speculum should be pushed slightly upwards every now and then, so as to stretch the mucous membrane and to open out its folds. Reflected light from a forehead mirror is necessary for this examination.

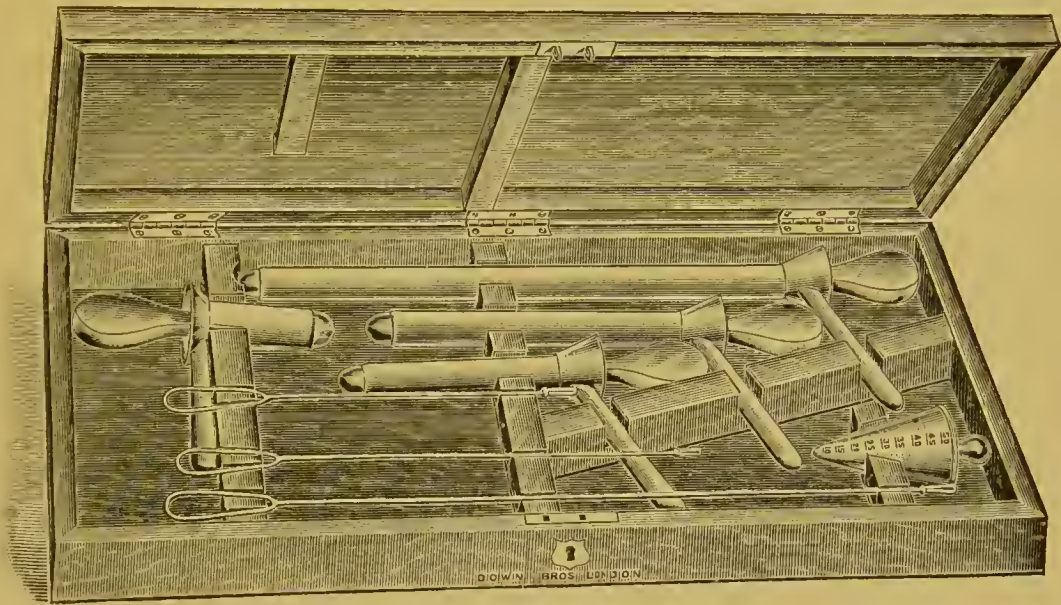


FIG. 5.—KELLY'S RECTAL SPECULA.

For examination of the bowel higher up the patient is put in the knee-chest position and a speculum—called the “long proctoscope”—about an inch in diameter and eight inches in length, is carefully introduced as high up as it will go. As the obturator is withdrawn air distends the rectum so that, with good illumination and by varying the position of the orifice of the speculum, the entire mucous membrane can be thoroughly inspected. Kelly also uses a still longer speculum that he calls the “sigmoidoscope,” and this instrument, which is 14 inches long, he states that he has introduced 12 inches beyond the anus. The introduction of this instrument must be effected with great gentleness. As it progresses upwards its point is directed to the patient's left. A fourth speculum, termed by Kelly the “sphincteroscope,” is a much shorter tube for examining the sphincteric area.

In addition to this physical examination, careful enquiries of course must be made as to the character of the stools, the existence and nature of discharges from the rectum, the occurrence of any protrusion during defæcation, etc. All these points will be referred to later.

CHAPTER II.

IMPERFORATE ANUS AND RECTUM.

THESE very important congenital deformities go by the generic term of "imperforate anus," but they are better divided into the two separate classes, imperforate anus and imperforate rectum. The condition is said to occur once in about every seven thousand children.

The rectum is developed from the hinder end of the primitive gut, and is therefore derived from the hypoblast and mesoblast. The anus, on the other hand, is developed from the cloacal depression in the epiblast, which gradually approaches the primitive gut until finally the septum between the two disappears and leaves a single tube. Simultaneously the anterior part of the cloacal slit is shut off from the alimentary canal and forms the urethra and the perineum.

VARIETIES.—Very varied malformations may be met with (see Fig. 6). Thus the rectum, and in some cases even the large intestine also, may be entirely absent; here, however, the anal depression is often well marked, but it also may be wanting. On the other hand, the rectum may be fully developed and the anal depression may be wanting; or both may be present but divided from each other by a definite septum. Hence the presence or absence of the anal depression gives no clue to the condition of the rectum.

The deformities may be grouped into the following classes:—1. The rectum and the anal dimple are both developed but are separated by a thin septum. 2. A part of or the entire rectum or even the large intestine also is absent; here the anal depression is present. 3. A commoner form is that in which there is no trace of an anus but the rectum is present. Occasionally both the anus and the rectum are entirely absent. 4. The anus may be developed but imperforate and the rectum may have formed a fistulous communication either with the skin—when the fistula opens somewhere near the perineum—with the scrotum or the penis, or, more frequently, with the bladder or urethra in the male or the vagina in the female. In addition to the true imperforate cases there may be atresia or a mere pinhole anus.

Thus, we have to consider the following groups:—Complete absence of the rectum or a considerable portion of it; a septum between the anus and the rectum; the existence of a rectum with or without an anus; and lastly, fistulous communications between the rectum and other parts.

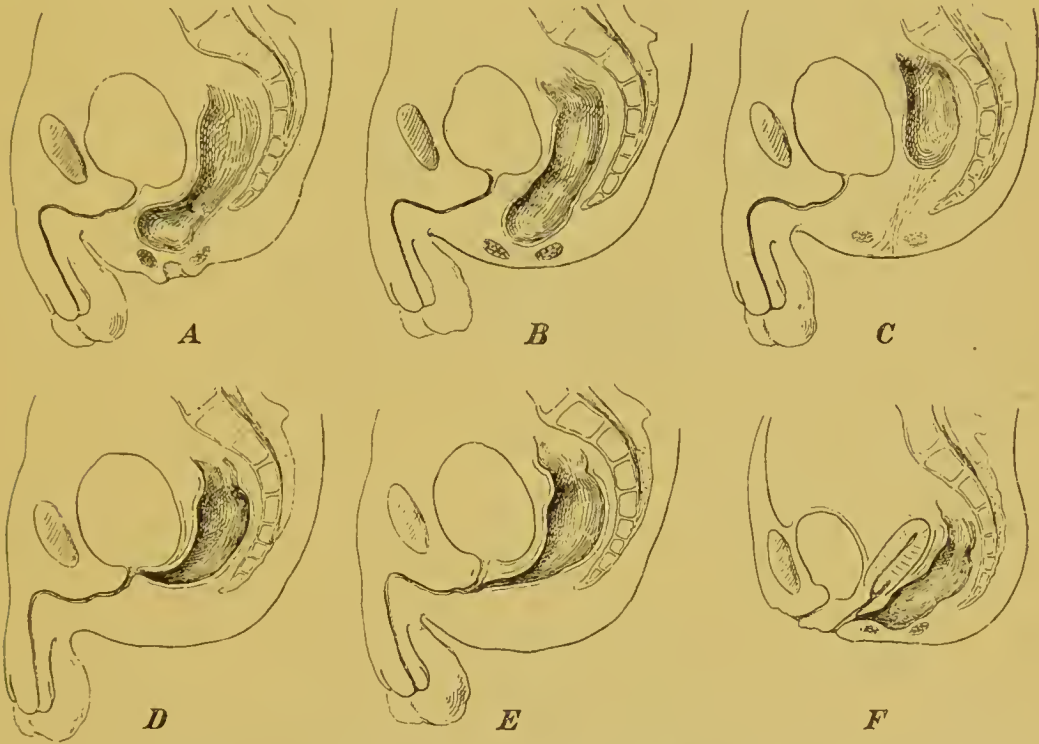


FIG. 6.—DIAGRAMMATIC REPRESENTATION OF THE DIFFERENT VARIETIES OF IMPERFORATE ANUS. *A* and *B* represent two common varieties; in the former the anal depression is developed, in the latter it is absent. In both the sphincter is developed and the rectum extends down to the perineum. In *C* the rectum ends high up in the pelvis. In *D*, *E*, and *F* there is a fistulous communication with the bladder, urethra, and vagina respectively.

When either the anus or the rectum is imperforate there is complete obstruction, and the patient must die unless speedy relief be afforded. When, however, a fistulous communication exists between the rectum and the skin, the bladder, the urethra or the vagina, it allows a certain amount of meconium to escape. The communication, however, is usually very narrow and may be tortuous, and the relief is incomplete, so that death, although somewhat longer delayed, will usually occur unless surgical intervention be practised. A similar result will attend a mere pinhole anus.

TREATMENT.—This, as a rule, is unsatisfactory. In the first place the child is only a few hours old and cannot stand prolonged or extensive operation; in the second place the parts are so small that anything like efficient manipulation is difficult; while in the third place there is more or less complete obstruction and the child's condition is as bad as it can possibly be.

(a) **Of a septum between the rectum and anus.**—These are the simplest cases to treat as the rectum and anus are well developed, and there is merely a diaphragm between the two. The finger passed into the anal dimple will usually feel the bulging of the lower end of the rectum when the child cries or when pressure is made upon the abdomen, and it is easy to make the two communicate by pushing a tenotome or small bistoury through the septum and dilating the puncture with sinus forceps. An opening just large enough to allow the escape of the meconium should be made at first, and this may be enlarged two or three days later by making a cross-cut through the septum and stretching it fully. The opening is kept dilated by a well oiled finger passed gently upwards through it two or three times daily. These diaphragms are usually thin, and a free crucial division usually gives quite good results if proper dilatation be maintained afterwards.

At least twelve months should be allowed to elapse before there is any attempt at discontinuing the dilatation, and then the finger should be passed at gradually increasing intervals in order to ascertain that no stricture is present. Should contraction occur, the case will become one of stricture of the rectum (see Chapter IV.), and must be treated as such.

(b) **When there is no indication as to the position of the lower end of the rectum.**—Here the anal dimple may or may not be present, but in either case the treatment is the same, for the first step is to make a careful search for the blind end of the gut from a median perineal incision which is gradually deepened until the bowel, if developed, is met with.

When the distended end of the gut presses down the perineum and bulges forcibly beneath the skin every time the child cries, it will be obvious that the rectum is fully developed and that only the anus is wanting. All that is then necessary is to make a median incision from the tip of the coccyx to the centre of the perineum and the end of the bowel will almost immediately present, showing its characteristic dark bluish-black appearance. A small incision is made into the centre of it with a tenotomy knife, the meconium is allowed to escape, and the edges of the orifice in the bowel are seized with tenaculum forceps, pulled down and secured by a few silkworm-gut sutures to each side of the skin incision.

When there is no bulging in the perineum to indicate that there is a rectum developed at all, the treatment becomes more difficult; in any case there will then be a fairly considerable thickness of soft parts between the skin and the blind end of the gut. The incision, which should be similar to that described above, must be steadily deepened, and the end of the rectum will be found fairly frequently at a depth of from half an inch to an inch. When this is not the case, the surgeon must gradually burrow up in the hollow of the sacrum in search of the gut, which, when found, should be seized with catch forceps on either side, gently separated from the surrounding structures, and brought down as far into the wound as possible before any opening into it is made. Stitches, through the muscular wall of the rectum only, are then substituted for the forceps, and their ends are passed through the skin on either

side of the anal incision. The bowel is now incised and the meconium allowed to escape. If the gut can be drawn down close to the skin it may be possible to suture the cut edge of the mucous membrane to the skin margin

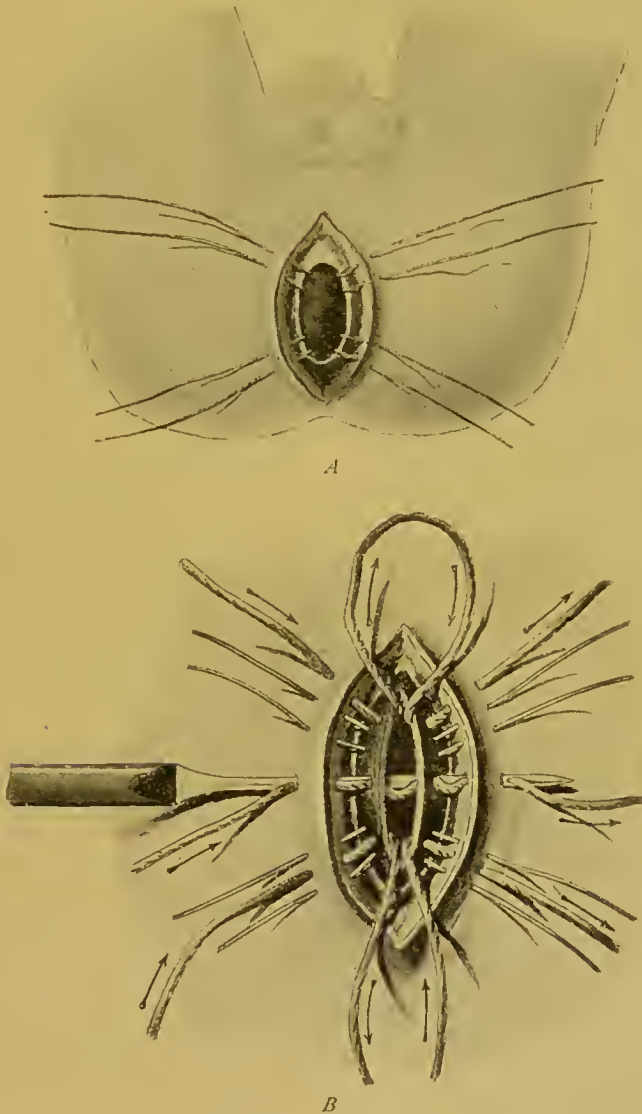


FIG. 7.—THE METHOD OF OPENING AN IMPERFORATE ANUS. The first stage is shown in *A*. Here the blind end of the rectum has been exposed, and before it is opened four sutures are passed, as seen in the diagram, in order to pull the bowel as far down as possible. *B* shows the method of suturing the mucous membrane to the skin after the bowel has been opened. The finer sutures are those seen in *A*, while the coarser ones, marked by the arrows, are those passing through the whole thickness of the rectal wall and uniting it to the skin. The centre suture of the three is in the act of being passed, in the upper one the thread has been seized and pulled out as a loop preparatory to being divided, while in the lowest one the loop has been divided and two sutures result.

with a few points of silkworm gut (see Fig. 7). A piece of oiled lint or a small drainage tube is then introduced into the bowel so as to keep the cut surfaces apart. In three or four days dilatation is commenced and kept up by insinuating a well-oiled little finger into the bowel, and this must be continued for a long time so as to prevent contraction (*vide supra*).

When the bowel is at some distance from the perineum it will be impossible to bring it down and stitch the mucous membrane to the skin as described above. Under these circumstances dilatation alone must be relied on to keep the opening patent after the operation. When there is much tendency to contraction afterwards, a very useful plan is to cause the child to wear a small indiarubber plug or teat, fastened in position by a T-bandage; this and the stretching by the passage of a finger daily may suffice to keep the stricture open until the child is old enough for a plastic operation upon the stricture to be performed with some prospect of success. It is quite impossible to do this at an early age owing to the smallness of the parts, and the child should be at least five or six years old before any attempt of the kind is made. The steps of the operation consist in separation of the mucous membrane above the stricture, excision of the latter, and suture of the separated mucous membrane to the skin at the anal margin.

When diligent search shows that the rectum is not present in the pelvis, and especially when the peritoneal reflection has been opened and still the end of the gut cannot be found, there is no alternative but to perform colotomy if the child's life is to be saved. This is a most serious procedure and, quite apart from the grave risks pertaining to it in a new-born infant, it is a terrible calamity to inflict on the child, and many parents will decline to permit it when the situation is explained to them as fully as it ought to be. If colotomy be decided upon, it must be done through a median incision, because it is impossible to say how much of the lower end of the gut may be absent. A median supra pubic laparotomy is performed, the end of the bowel is found and brought out through the wound, a Paul's tube is inserted and the end of the bowel secured in position, as for an ordinary colotomy with immediate opening of the gut (see Part VI., Sec. I., p. 325).

Elaborate operations, such as bringing down the bowel to the anal opening after it has been found by abdominal section, are quite out of the question in infants a few hours old such as these are. There is nothing for it but to make an artificial anus, at any rate temporarily; should it be deemed possible to bring the rectum down at a later period, that may be attempted when the child is a few months older. It is hardly necessary to remark, however, that, even at this age, the child is scarcely likely to stand what must necessarily be a prolonged and most severe operation.

(c) When there are fistulous communications.—The only cases at all promising for permanent recovery are those in female infants in which the fistula runs into the vagina. The immediate treatment will depend on the condition present. *When there is a fistulous communication with the vagina* a fine probe bent at the end is introduced along the fistulous track from the vagina, and its point is turned downwards and pressed against the anal dimple or the skin in that region if no dimple exists. The point of the probe is cut down upon by a median incision from the centre of the perineum to the coccyx. When the bowel is found it is opened as already described, sutured to the skin if possible, and kept dilated afterwards (see p. 11). The fistulous track

into the vagina is best left until the patient has grown up; by that time the fistula may have closed so completely that nothing further is necessary; should it persist it may be closed in the usual manner by dissecting out the fistulous track and suturing the mucous membrane of the vagina and the rectum separately.

When the fistula communicates with the bladder or the urethra, the treatment is extremely difficult. In the former case the risks of suppurative nephritis are very great, and the child usually dies. It may be possible to open the rectum from the perineum when the communication is with the urethra, and the bowels should then be regulated so that the fæces are kept solid and therefore less likely to find their way into the urethra. This may be successful, and the child may escape suppurative nephritis. When, however, the opening is into the bladder the gut generally terminates high up in the pelvis, and cannot be reached from the perineum. Here an inguinal colotomy is the only alternative, and the bowel should then be completely divided across,¹ the upper end being fixed into the wound, after a Paul's tube has been tied in (see Part VI., Sec. I., p. 325), whilst the lower end is invaginated and sutured so as to prevent any possibility of meconium finding its way into the bladder. This is of course an operation of the greatest severity in a child of this age, and few will survive it; even should the child live, it will grow up with a permanent artificial anus which can never be remedied. In face of such a lamentable prospect as this the parents will probably refuse to allow the operation.

¹ This should be done as near to the bladder as is consistent with proper invagination of the lower end, in order to leave as little as possible of the bowel communicating with the bladder.

CHAPTER III.

INJURIES OF THE RECTUM: FOREIGN BODIES.

INJURIES OF THE RECTUM.

INJURIES of the rectum are fortunately not very common, for when they do occur they are very serious. They may be met with:—1. In association with fractures of the pelvis (more particularly fractures of the sacrum); and 2. as the result of the penetration of foreign bodies.

Lacerations of the rectum, produced by fractures of the pelvis or sacrum, are of extreme gravity, as there is a communication between the intestine and the fracture which is often followed by fatal septic, spreading pelvic cellulitis. The rectum may be completely torn across, and here the result is usually fatal. The patient is often so collapsed that any attempt to carry out the obvious line of treatment, namely, the repair of the injury to the rectum and the cleansing of the peritoneal cavity, is quite out of the question.

Penetrating wounds of the rectum.—These may be due to the penetration of a foreign body, as when the patient falls in the sitting position on to a pole or a stick, and they may occasionally be produced by the surgeon; as, for example, in using Davy's lever for compressing the iliac arteries in amputation at the hip. Minor degrees of wound of the rectum are also produced by foreign bodies introduced into the bowel.

The seriousness of an injury of this kind depends upon whether there be actual penetration of the rectal walls either into the peri-rectal cellular tissue or into the peritoneal cavity. When the mucous membrane alone is injured the prognosis is much less grave, the chief risk being hæmorrhage, which may be free and which is especially serious from the fact that it may go on for a long time unnoticed because the contraction of the sphincter may prevent the escape of blood externally, and enormous distension of the rectum with blood-clot may thus occur.

TREATMENT.—This will vary according as the case is one of a laceration associated with the fracture of the pelvis or of a wound from a foreign body, and the treatment of these again will vary according as the

wound is penetrating or non-penetrating, *i.e.* perforates the entire rectal wall or only one of its coats; and lastly whether the penetrating wound passes into the peritoneal cavity or only into the peri-rectal cellular tissue.

(a) **Of lacerations associated with fracture.**—When the bowel is torn across as an accompaniment of a fracture of the pelvis or sacrum the case is most serious.

When the laceration extends into the peritoneal cavity the natural line of treatment is clearly to do a median sub-umbilical laparotomy, to find and try and repair the wound in the rectum and to thoroughly cleanse the peritoneal cavity, as in any other case of wound of a hollow viscus. These cases are usually associated with extensive fracture of the pelvis and in the majority the patient's condition is too desperate to allow this to be undertaken, and death from septic peritonitis occurs. Should there be any prospect whatever of successfully carrying out this method of treatment it should of course be undertaken. The details of it are practically the same as for a similar injury to the stomach. The abdomen should be opened in the middle line immediately above the pubes and, after the extravasated faecal material has been removed from the pelvic or general abdominal cavity by the methods already indicated for the stomach (see Part VI., Sec. I., p. 208), the patient should be put in the Trendelenburg position so that the intestines fall out of the pelvis, and the wound in the rectum should be searched for and sutured in the ordinary manner if possible. This may be excessively difficult especially when the rent is low down and is partly intra- and partly extra-peritoneal.

Much the same remarks apply to the cases of extensive *laceration of the rectum below the reflection of the peritoneum*,—an injury which is more commonly associated with a fracture of the sacrum than of the pelvis as a whole; in the latter case the patient's condition will probably negative any attempt at operative interference, but when the injury is due to a fracture of the sacrum and there is no marked shock the best plan is to cut down by the side of the bowel and try to reach the seat of injury from the perineum. This is done by a crescentic incision around that side of the anus on which digital examination shows the injury to be. The incision is deepened up into the ischio-rectal fossa until the rent is reached, and then the tissues are thoroughly opened up and packed with iodoformed gauze so as to provide for drainage and prevent as far as possible the septic cellulitis which will otherwise certainly occur; an incision of this kind gives free exit to any slough or discharges that may occur.

(b) **Of wounds caused by foreign bodies in the rectum.**—*When the wound is non-penetrating*, that is to say, only injures the mucous and perhaps the sub-mucous coats of the bowel, the treatment is to dilate the anus fully under a general anæsthetic and to examine the mucous membrane thoroughly by means of Kelly's tubes (see p. 6). When the seat of injury is found, the hæmorrhage is arrested by tying or under-running the bleeding point or, if necessary, by leaving a pair of clamp

forceps in position should the spot be too high up to be amenable to ligature. In many cases it is sufficient merely to clean the surfaces, to rub in iodoform and to leave the injured part to heal.

When the foreign body has penetrated the rectal wall below the peritoneal reflection, the peri-rectal cellular tissue behind it will require free drainage, as in similar cases associated with fracture of the sacrum (*vide supra*), as otherwise very fatal septic pelvic cellulitis is almost certain to occur. Drainage is best effected by the perineal route that has already been described for similar affections associated with fracture. It is well to confine the bowels for a few days afterwards in order to allow of healing, and then subsequently to keep them open by suitable laxatives. The wound should be thoroughly rinsed, and frequently syringed out with mild antiseptics, in order to get rid of all particles of fæces.

Should the patient be in a condition to stand the operation well, a temporary inguinal colotomy, to be closed when the patient recovers, will increase the chances of recovery by diverting the intestinal contents from the wound, and this should certainly be resorted to in addition to the perineal operation just described when the rupture is extensive and the cellular tissue in the hollow of the sacrum is widely opened up. It not only diminishes the danger of bad sepsis but it gives a good chance of obtaining healing without any fæcal fistula. In nearly all cases in which it is necessary to open up the pre-sacral tissues down to the wound in the rectum a fæcal fistula results. If, however, the fæces be diverted for some weeks the tissues may heal without any such uncomfortable complication, and this is a point of very great importance. The colotomy must of course be done so that the interruption to the passage of the fæces is complete and its repair subsequently will necessitate a complete end-to-end union of the sigmoid flexure. This, however, is a comparatively easy and safe operation (see Part VI., Sec. I., p. 306).

When the rent runs into the peritoneal cavity the shock is much less than in corresponding cases of fracture of the pelvis, and a median supra-pubic laparotomy should be done, with the patient in the Trendelenburg position, and an attempt made to repair the injury (see p. 15).

FOREIGN BODIES IN THE RECTUM.

Foreign bodies may find their way into the rectum from above or from below; in the former case they are either comparatively small objects, such as fish-bones, which have been swallowed, or they consist of a gradual accumulation of indigestible material, such as the skins or pips of fruits, cherry-stones, or indigestible portions of vegetables which form a nucleus on which fæcal material and salts are deposited so as to give rise to an enterolith.

Apart from these causes, the normal intestinal contents may form a dense hard mass in the rectum, and this condition is most common in

elderly persons who are the subjects of habitual constipation with almost complete absence of intestinal peristaltic power. This fæcal impaction may take the form either of one huge mass which dilates the lower end of the rectum and blocks up the anus like a ball-valve, or of distension of the rectum and the greater part of the large intestine with hardened masses which the bowel makes no effort to pass on.

The other forms of foreign body met with in the rectum are those introduced through the anus, and an enormous variety has been met with from a small stone or marble up to a large object like a soda-water bottle.

SYMPTOMS.—The symptoms of a foreign body in the rectum are mainly those of the proctitis produced by it; namely, tenesmus and the passage of blood and mucus. The sharp bodies are apt to injure the mucous membrane and to produce an acute suppurative condition and frequently cause ischio-rectal abscess and fistula in ano. There may be obstruction if the body be large.

Fæcal masses impacted in the rectum also set up a condition of proctitis which leads to an irritative diarrhoea with the passage of large quantities of mucus and a small quantity of fæcal material. There is generally some absence of control over the anus, and the patient shows signs of stercoral poisoning and has all the symptoms of chronic obstruction.

TREATMENT.—The removal of any foreign body should be effected as soon as possible and no special rules need be given. The patient must nearly always have an anæsthetic and the sphincter should be dilated; then the body can be inspected and removed as may seem best. Small, sharp bodies can usually be extracted at once by forceps when the anus has been dilated, either through a speculum or not as the case may be. When the foreign body is a jagged object, such as a piece of broken glass, etc., removal must be effected extremely carefully lest deep-seated injuries to the rectal wall and peri-proctitis should occur. These objects are best broken up still further by cutting pliers and removed piecemeal.

In cases of fæcal impaction, the mass must be broken up and removed with a spoon, forceps or any other suitable instrument, and the débris flushed out with a large cnema. The operation should be done under an anæsthetic after full dilatation of the sphincter. The treatment of these cases is of course not completed by the removal of the impacted mass, for the predisposing condition, namely, obstinate constipation, requires careful treatment also. The use of strychnine and belladonna internally, combined with abdominal massage, which is very useful indeed, and the daily use of a weak Faradic current, one pole being placed over the sacrum and the other passed over the abdominal wall and introduced into the rectum, are very valuable. Dietetic and hygienic rules, for which the reader is referred to medical text-books, must also be imposed. Purgatives are of little value.

CHAPTER IV.

INFLAMMATORY AFFECTIONS OF THE RECTUM.

ACUTE PROCTITIS.

INFLAMMATION of the rectum is comparatively common as a sub-acute or chronic disease.

The acute form is rarer and may occur in connection with dysentery, with various operations about the anus or the lower end of the rectum, with injuries from foreign bodies, with ulcerative colitis or as the result of bacterial infection. Acute proctitis may also follow gonorrhœal infection, either as an extension from the vagina or as the result of pederasty.

The acute catarrhal inflammation of the mucous membrane is accompanied by much congestion and results in bad cases in ulceration or actual sloughing of the mucous surface. The tendency however is towards cure, provided that the exciting cause be removed and proper rest given to the bowel. In very acute cases the infection may extend through the wall of the rectum giving rise to peri-proctitis (see Chap. VI.). Should the condition persist it passes into a chronic proctitis, either of the proliferative or ulcerative form (*vide infra*).

SYMPTOMS.—There is distressing heat and weight about the rectum, discomfort in the pelvis and often considerable pain accompanied by tenesmus and the frequent passage of small quantities of fæcal material mixed with mucus and often tinged with blood. If the disease be very acute and be going on to sloughing there may be actual suppuration from the mucous surface. Irritability of the bladder is also a frequent symptom, whilst the anus is generally painful and may be red. Digital examination is painful and, for a thorough investigation, a general anæsthetic is advisable. This is not only a valuable help in diagnosis but is of the highest importance in treatment, because the sphincter can then be thoroughly dilated, and this gives rest and does much to relieve the tenesmus.

TREATMENT.—The first essential is to remove any cause, such as a foreign body, worms, etc. The patient should be confined to bed, the bowels should be kept open, at first by salines and afterwards by gentle laxatives.

For severe pain, suppositories containing two grains of opium with half a grain of extract of belladonna, or an enema of an ounce of thin starch containing thirty to forty minims of laudanum, may be administered every four hours if necessary. Hot fomentations to the perineum and anus or a hot sitz bath are very comforting in bad cases. When the sphincter has been dilated and the patient can bear it, irrigation of the rectum with dilute Condyl's fluid or boracic lotion at the body temperature should be practised two or three times daily. This is readily done with a douche can and a soft double-way tube; the latter is introduced well up the rectum and the can raised about two feet above the level of the pelvis. This will wash away mucus and give much relief. After the irrigation the skin round the anus should be dried and dusted with equal parts of oxide of zinc, boracic acid and starch. As the disease subsides the patient should have general tonic treatment.

CHRONIC PROCTITIS.

This condition may follow the acute form (*vide supra*) or it may be chronic from its commencement, as for example when it is associated with prolapse or piles. Gonorrhœa of the rectum may pass into a chronic condition, and there are also certain non-specific forms of hypertrophic and stenosing proctitis which are chronic in their onset. No doubt the most common causes of chronic proctitis are syphilis or tuberculous disease, but these are considered separately (see Chap. V.).

VARIETIES.—In chronic proctitis the inflammation may affect only the mucous membrane or it may extend to the sub-mucous tissue, and it usually involves the greater part of the rectum, although it generally affects the lower end most. The mucous membrane is red and swollen, and there is a somewhat free discharge of mucus from it. Hypertrophies of the glandular tissue giving rise to papillomatous vegetations often occur, and this form is known as papillomatous proctitis. After infiltration of the sub-mucous tissue has lasted for some time the natural tendency is to contraction of the lumen of the bowel. Chronic proctitis, after it has lasted for some time, may become complicated by inflammation and possibly suppuration around the rectum.

Simple chronic proctitis.—The milder forms, such as occur in connection with foreign bodies or in the neighbourhood of an ulcer of the rectum, are generally limited to the mucous membrane and usually disappear when the cause is removed.

Ulcerative proctitis.—The most important form of non-specific origin is that characterised by a superficial ulceration of the mucous membrane (ulcerating proctitis), or by vegetations of glandular origin arising from the surface (papillomatous proctitis), or by both combined. Another important form is that in which the inflammation extends to the sub-mucous tissue, so that there is thickening and contraction of the walls of the rectum (stenosing proctitis). These forms are often combined at a late stage, an

ulcerative or papillomatous proctitis becoming, after a time, complicated with sub-mucous infiltration and consequent stenosis.

Ulcerative proctitis may occur under various conditions: it may follow traumatism; it may be a sequel to an acute inflammation in which an abscess forms or in which there is extensive sloughing; it may complicate hæmorrhoids. When an ulcer of the rectum has formed just above the sphincter it may remain open for a long time, as the contraction of the sphincter and the accumulation of fæcal material above it retard healing very greatly.

Papillomatous proctitis may occur alone, but is usually met with in connection with the ulcerative form just referred to. It is characterised by a large number of warty vegetations springing from the glandular elements of the mucous membrane, which vary much in size and extent. There is no induration about their bases.

Stenosing proctitis may occur in connection with non-specific inflammations about the rectum, but is undoubtedly usually due to syphilis. It is characterised by inflammation of the submucous tissue, accompanied by ulceration of the mucous surface, and the result is atrophy of the mucous membrane, with gradually increasing rigidity of the walls of the rectum and progressive stenosis, which takes place irregularly, so that the lower end of the bowel becomes converted into a narrow tortuous canal. The condition is usually confined to the lower end of the rectum.

The ulceration present gives rise to the greatest difficulty in treatment, as the pain due to the ulceration interferes with proper dilatation of the stricture. The bowel above the latter is dilated and early in the case becomes hypertrophied, the amount of dilatation being proportionate to that of the stricture present.

SYMPTOMS. (a) **Of ulcerative proctitis.**—The symptoms are not very marked, unless the ulceration involves the sphincteric area. The chief troubles are discomfort, frequent stools and free discharge of mucus, often tinged with blood. When the ulceration involves the sphincters, symptoms of fissure of the anus are often present (see p. 42). An examination with a speculum will detect the ulcer, and this should always be used, because the finger may fail to detect a small ulcer unaccompanied by any induration.

(b) **Of papillomatous proctitis.**—These are similar to those of the preceding form. The actual diagnosis is made by the speculum. If the vegetations be large they may prolapse through the anus.

(c) **Of stenosing proctitis.**—The first symptoms are those of simple proctitis (see p. 19). Later on there are the painful symptoms due to ulceration accompanied by those of gradual stenosis. Thus the patient suffers from alternate attacks of constipation and diarrhœa, and the motions are flattened or like pipe stems, and there is increasing difficulty in passing them. There is frequent tenesmus, with griping pain in the colon, and the amount evacuated is usually very scanty and consists chiefly of muco-pus. In advanced cases there is often some abdominal distension, and, when the

terminal portion of the rectum is affected, there may be incontinence of feces.

These cases may persist for many years, but, after having lasted for some time, the general health suffers from the fecal absorption, and the patient becomes sallow, dull, and apathetic, with a bad appetite and exhales a characteristic offensive odour. As the stricture increases in tightness various complications may bring about death; the chief of these are septic complications, such as ulceration and abscesses. The patient may also die from exhaustion quite apart from any actual attack of obstruction.

The chief difficulty is to distinguish between a simple stricture and a malignant one, especially that form in which there is an annular constriction without much outgrowth into the rectum. The non-malignant stricture is usually fibrous and elastic to the feel, is very irregular and may be extensive, while there is not that definite induration characteristic of rectal carcinoma. The length of time that the affection has lasted is also of importance, and, in addition, a history of some previous inflammatory mischief can usually be obtained in non-malignant cases, which are generally of very slow development, whereas the malignant form produces obstruction very early.

TREATMENT. (a) **Of simple chronic proctitis.**—This is much the same as that of the acute form (see p. 18). The cause should be searched for and removed. The bowels should be kept gently open, while the patient is put to bed and confined to a milk diet. The rectum should be frequently irrigated, first with dilute Condyl's fluid or boracic lotion and later with such mild astringents as a solution of perchloride of iron (grs. 2 to the ounce), tannin (grs. 5 to the ounce), or nitrate of silver (gr. $\frac{1}{8}$ to the ounce). In the intervals between the irrigations a suppository containing sub-nitrate of bismuth, 20 grains, and cocaine, half a grain, is often very useful, and there may be added a grain of opium to each suppository if there be much pain.

(b) **Of ulcerative proctitis.**—The patient must be kept absolutely at rest in bed in the recumbent position and the bowels should be cleared out at first by a purge and afterwards by laxatives, whilst the diet should consist mainly of milk. Gas should be administered and the sphincter thoroughly stretched, and this should be repeated every few days as muscular power recovers. It may even be necessary in very bad cases to divide the sphincters, but this is a serious procedure which should only be undertaken as a last resort. For the treatment of bad tenesmus a starch and opium enema (see p. 19) may be given every three or four hours, and this may usefully be combined with irrigation of the rectum with warm antiseptics, followed, as the affection subsides, by weak astringents (*vide supra*) night and morning.

Should the ulcers be sluggish in healing they may be touched with solid nitrate of silver through a glass rectal speculum. The action of the caustic should be neutralised after it has acted for a few minutes by thoroughly washing out the rectum with salt and water.

When the ulceration is limited to the lower part of the rectum and refuses to heal under milder treatment, it has been suggested to remove the whole of the mucous membrane over the sphincteric area and to detach that above it for some little distance, so as to enable it to be brought down and sutured to the skin at the anal margin, almost exactly as in Whitehead's operation for piles (see Chap. VIII.). In extensive cases, with severe pain and no sign of healing, a temporary inguinal colotomy should be performed, after which the sphincters should be kept dilated and the rectum irrigated through from the inguinal opening. This will usually allow healing to occur, after which any contraction present may be remedied by dilatation with bougies. After this has been done the colotomy opening may be closed in the usual manner (see Part VI., Sec. I., p. 469).

(c) **Of papillomatous proctitis.**—The vegetations must be got rid of and the best way of doing this is to use the thermo-cautery or the galvanic loop. The sphincter should be fully dilated under a general anæsthetic, after which it is generally possible to bring down the whole of the affected area through the anus, or to deal with it through a speculum, unless it extend unduly high up, in which case it may be essential to incise the sphincters and the posterior wall of the rectum backwards to the coccyx in the middle line so as to give access to the upper part of the rectum. This should only be done however in extremely bad cases.

(d) **Of stenosing proctitis.**—The treatment of this form of chronic proctitis and its accompanying non-malignant stricture of inflammatory origin is very difficult. The condition inevitably gets worse if left alone, and something must therefore be done. In the early stages irrigation with warm antiseptics, the employment of laxatives and the removal of any definite cause of proctitis, together possibly with the administration of anti-syphilitic remedies is the proper line of treatment. Later on, as the condition becomes complicated by stenosis, vigorous treatment must be directed to this.

The main difficulty is the extreme sensitiveness of the affected region. Another is the irregularity of the stricture and the serious danger of sepsis following any breach of surface. This is most important, because infective material may pass through the torn wall of the rectum and give rise to a peri-proctitis, which may end fatally, or, if the patient survive, in abscess and fistula high up in the bowel, which it is very difficult to treat and which may require free division of the sphincters.

In very slight cases following injury and extensive pile operations or excision of portions of the mucous membrane, the treatment is comparatively easy because there is no deep ulceration or marked infiltration of the rectal walls; any cicatricial bands present merely draw the mucous membrane together and very often do not involve the other coats.

In some of these mild cases the stricture may be overcome by dilatation with the finger or with rectal bougies passed through the stricture every two or three days (*vide infra*). When constriction is very slight and situated about the anal orifice, as after an operation for piles, a permanent cure may

be obtained by excision of the cicatricial tissue followed by suture of the mucous membrane to the skin, or by mere linear division of the stricture and suturing the wound subsequently so that the scar is at right angles to the original incision, as is done in pyloroplasty.

However, in chronic stenosing proctitis the conditions are different; the ulceration may have subsided, leaving an extensive and tortuous contraction, or there may be active ulceration in addition to the latter. The treatment in both cases is very difficult and unsatisfactory; as a rule it is easier when there is no ulceration, and the case is therefore practically one of uncomplicated stricture.

In cases of uncomplicated stricture, a trial should first be made of *dilatation by bougies* or Hegar's dilators,—a method closely analogous to the gradual intermittent dilatation of a urethral stricture. The bowels having been well cleared out previously, the patient should lie on a couch in the

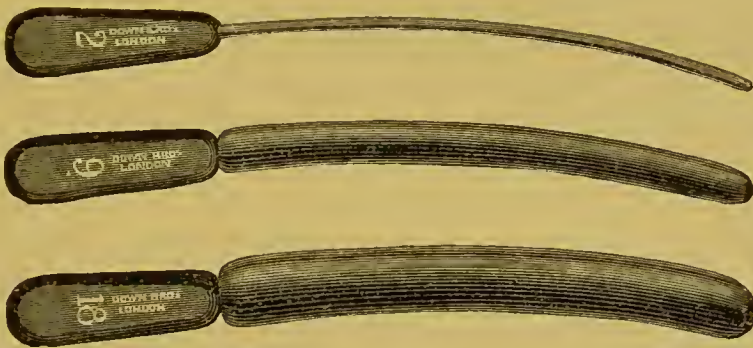


FIG. 8.—METAL RECTAL BOUGIES.

lithotomy position. The surgeon takes a well-oiled and warmed bougie of suitable size (see Fig. 8), and tries to insinuate it very slowly through the stricture; the greatest gentleness must be observed, and it is probable that, if the stricture be of any length, only the lowest portion can be dilated at the first sitting. Subsequently however more progress can be made, until ultimately the instrument traverses the entire length of the contracted portion. The bougie should be left *in situ* for a few minutes, when, unless it be very tightly grasped, another, the next size larger, is gently passed after the first is withdrawn. Dilatation however should never be pushed beyond what the patient can comfortably bear, and never to such an extent as to tear the surface of the mucous membrane.

At first, two or three days should be allowed to intervene between the sittings, while later on, as dilatation progresses, the interval may be extended up to a week. When full dilatation has been established, an interval increasing up to a month may be allowed if it be found that no contraction has taken place meanwhile. During the entire period the bowels should be kept well open, and at each sitting a bougie, one size smaller than the largest passed at the previous sitting should be used to commence with. The bougies should be always passed by the surgeon himself until the stricture

is fully dilated ; attempts on the part of the patient may end in serious pelvic cellulitis which, if not fatal, will lead to extensive fistulæ.

When the stricture extends only a short distance, say half an inch or so along the rectum, an *expanding rectal stricture dilator* (see Fig. 9) may be used with advantage. The instrument is introduced through the stricture with the blades closed, and the latter are then cautiously expanded. The advantage of this instrument is that the dilatation can be gradually increased without having to withdraw one instrument and introduce a fresh one. It is only useful for limited strictures in which, however, it is of great value.

Rapid dilatation or forcible stretching or splitting of the stricture has been practised, but cannot be too strongly condemned because, quite apart from the shock which must necessarily ensue, there is a grave risk of septic infection of a severe type. Even if the patient escapes these risks, there is the certainty of increased contraction afterwards.

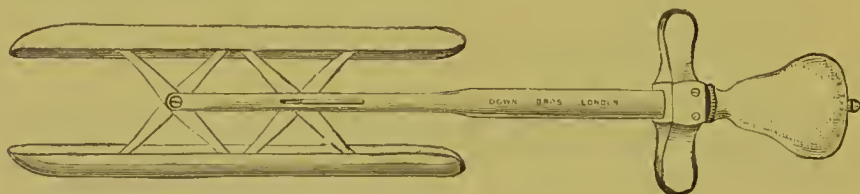


FIG. 9.—RECTAL DILATOR. The blades, which are separated by a screw-action, are kept parallel throughout.

Internal proctotomy.—This procedure, closely analogous to internal urethrotomy, is of very doubtful value except when practised for a superficial cicatrix, which only involves the mucous membrane. Division of strictures involving the entire thickness of the rectal wall will lead to the introduction of septic material into the peri-rectal tissues and is not good practice. Electrolysis is apparently not of any permanent value.

External proctotomy, or free longitudinal division of the stricture prolonged down through the sphincters and the skin of the anus externally has also been tried. The wound thus made is packed with gauze to prevent it from closing for some time, in the hope that epithelium will spread along the surface and so enlarge the calibre of the lower end of the rectum. When, however, healing is complete, the constriction is usually as bad as ever and the patient is in a worse condition than before because the sphincters have been seriously damaged.

Excision of the stricture is theoretically the ideal radical method, but in practice it is not at all successful. The two main difficulties connected with it are that on the one hand the stricture, especially when following extensive syphilitic ulceration, may be so long as to render re-union impossible. The inflammation may spread up to the sigmoid flexure, the peritoneal surface of which may be so affected that the gut is bound down in the iliac fossa and an excision is out of the question. Moreover, the operation is necessarily accompanied by great danger of septic infection. Should infection occur

and the patient survive, the inflammation set up in the pelvic cellular tissue is apt to reproduce the contraction. Nevertheless, this method must be borne in mind and carefully weighed before it is dismissed in any case of limited stricture. Should it be decided upon, the best result will be obtained if a temporary colotomy wound be made previously so as to obviate the passage of fæces over the wound. This is advisable to avoid the risk of sepsis, to allow the incision to heal without much inflammation and subsequent contraction, and also to avoid the risk of a fistula subsequently. After healing has occurred, the colotomy wound can be closed in the ordinary manner (see Part VI., Sec. I., p. 469).

The steps of the excision will vary according to the position of the stricture, and the operation is most valuable for strictures low down where the induration can be removed without injuring the sphincters. It is very similar to Whitehead's operation for piles (see Chap. VIII.). For more severe cases either the perineal or Kraske's method (see Chap. X.) of excising the rectum must be adopted according to the situation and extent of the stricture.

Colotomy.—Should the stricture become blocked so frequently that the patient is constantly getting attacks of obstruction and suffering from distressing diarrhoea, and should the foregoing methods fail to relieve the symptoms, colotomy must be performed (see Part VI., Sec. I., p. 362). This is still more urgently indicated when ulceration accompanies the stricture, and it is then done mainly to allow the ulceration to heal, without which it would probably never do. After colotomy the ulceration heals and induration about the stricture diminishes, and the latter becomes gradually amenable to dilatation, and therefore in many cases the colotomy need only be a temporary measure. The situation of the opening will depend on the extent of the proctitis. When the inflammation is limited to the rectum the ordinary left inguinal operation (see Part VI., Sec. I., p. 362) is the proper procedure. When however the induration extends to the sigmoid flexure it will be well to open the transverse colon in order to get well above the ulcerated area. In doing the colotomy it is best to make a complete section of the bowel so as to entirely interrupt the passage of fæces. There is no occasion, however, to remove a large coil as is done in colotomy for cancer of the rectum (see Chap. X.) where there is no likelihood of ever restoring the canal.

After the colotomy, the rectum should be syringed out both from above and below with mild antiseptic solutions, such as boracic acid, Condy's fluid or sanitas, and after a few weeks of this, a more methodical treatment may be undertaken. Any ulcerated area remaining unhealed may be painted with strong solutions or touched with solid nitrate of silver and, after healing has occurred, gradual dilatation of the stricture must be taken in hand. By persevering in this manner and taking several months over the treatment, the lumen of the rectum may be so much restored that it will be safe to close the colotomy wound, as described for fæcal fistula and artificial anus (see Part VI., Sec. I., p. 469).

It must not, however, be expected that this happy result will often occur. Generally the patient will have to go through life with a colotomy opening, but, even so, his condition is much better than before, for he is freed from the constant pain, tenesmus and obstruction, and in many cases he has as much control over the colotomy opening as he had before over the anus.

When the stricture is complicated with active ulceration the patient's distress is considerable. Diarrhœa, accompanied by the passage of blood, mucus and pus, is constant and wears out the strength rapidly. Here the passage of bougies will not do much good. In strictures near the anus the use of the screw dilator (see Fig. 9) every second or third day is much better than bougies. If the stricture can be fully dilated by it the ulcers will probably heal.

In most cases however the pain is so severe that the surgeon has to make a choice between colotomy and external proctotomy, and in most cases the former will be indicated. In these cases, especially when they are due to syphilis, the surgeon must be prepared to find the sigmoid flexure so bound down in the iliac fossa that left inguinal colotomy cannot be easily performed: if the sigmoid flexure cannot be detached from its adhesions and brought up to the surface sufficiently to enable the bowel to be cut completely across subsequently, the transverse or the ascending colon, preferably the latter, must be opened through a fresh incision (see Part VI., Sec. I., p. 360).

CHAPTER V.

SYPHILIS AND TUBERCULOSIS OF THE RECTUM AND ANUS.

SYPHILITIC AFFECTIONS OF THE RECTUM AND ANUS.

SYPHILIS may be met with in these parts in all its stages. The **Hunterian chancre** at the anus is not very rare, and occurs more frequently in women than in men. It is generally seated about the anal margin, but may be actually within the rectum, usually in the sphincteric area.

The diagnosis is most important as the sore may be mistaken for a carcinoma of the rectum. The appearances are almost precisely those of chancre elsewhere with the exception that, owing to the irritation of the fæces, there is more inflammation and ulceration and, when the chancre is situated well within the anus, the inflammation about the base may be so marked as to strongly suggest malignant disease. The size of the sore, its general characters, the absence of outgrowths from it must all be taken into consideration in making the diagnosis. The glands first affected in chancre about the anus are the inguinal chain, while in one situated within the bowel enlarged glands may be felt in the hollow of the sacrum. One of the chief points of distinction between carcinoma and chancre in this situation is the limitation of the ulceration in a chancre and the absence of the foul, sloughing irregular surface, which is common in carcinoma. In a short time secondary symptoms will of course occur, and then the diagnosis will be clear.

Treatment.—This is the same as that for chancre elsewhere (see Part I., p. 230), but, owing to the great pain and irritation that the patient suffers, it is important to obtain the physiological effects of mercury as soon as possible and therefore one of the more rapid methods, such as inunction, fumigation, or intra-muscular injection should be chosen. Locally, suppositories containing calomel and opium are very useful, and if necessary they may be combined with a little cocaine.

In the secondary stage syphilitic affections are frequently met with about the anus; the rectum itself is rarely affected, except in the tertiary period. The typical manifestations are mucous tubercles or condylomata.

These are very important, because the condylomata are constantly being mistaken on superficial examination for hæmorrhoids, and the small ulcers for fissures of the anus, and very serious results may follow such a mistake, for not only is there no necessity for any operative interference in these syphilitic cases, but the discharges are excessively infective and it is most important therefore that a clear diagnosis should be made.

The large condylomatous masses are usually situated close to the anal orifice, but there is often an interval of healthy skin around the anal margin which at once distinguishes the condition from hæmorrhoids. The condyloma is a sessile, ovoid swelling, with its long axis generally radiating from the anal orifice, presenting a characteristic greyish-white surface and discharging a thin, watery fluid. With care the condition cannot well be mistaken.

Treatment.—The ordinary anti-syphilitic internal remedies (see Part I., p. 231) must be administered, while the best local treatment is to keep the parts dry and clean, and dust them with calomel and starch (calomel one part, starch three). It is also advisable to introduce a pad of boracic lint between the buttocks so as to prevent the two sides touching, because the discharges are very irritating and fresh masses may be produced at any point of contact. Under this simple treatment the condylomata dry up in a few days.

Similar treatment will apply to large mucous patches accompanied by ulceration about the anus: but there success may not be so readily attained, and it may be necessary to stretch the anus and cauterise the ulcer with pure carbolic acid or solid nitrate of silver, because, when ulceration has occurred, a fissure of the anus is apt to persist in spite of the improvement in the syphilis.

The most important affections are, however, the **tertiary lesions**, which are essentially extensive ulcerating syphilides; typical gummata, either in the rectum or about the anus, are rare. The condition is comparatively uncommon about the anus; when it occurs it takes the form of an ulceration, spreading somewhat deeply and irregularly, and leading to serious contraction. The usual condition is a deep tertiary ulceration of the surface of the rectal mucous membrane, more commonly met with in women than in men, in which chronic constipation is a frequent predisposing factor. Ulceration may appear at any time between the late secondary and the early tertiary periods, and usually occupies the lower part of the bowel, in the great majority of cases spreading from below upwards, and sometimes extending as high as the sigmoid flexure and causing serious obstruction. The fact that the mucous membrane is usually involved right down to the anal orifice is a very important point in diagnosing this condition from malignant disease, in which the mucous membrane about the anus is usually unaffected.

The ulceration occurs primarily in the mucous membrane and sub-mucous tissues, but is soon accompanied by marked induration of the walls of the bowel. This condition is one of the chief causes of the extensive ulcerations

and stenoses of the lower bowel, to which reference has been made under the head of Chronic Proctitis (see p. 19). The ulcers usually present clean-cut edges and are very irregular in outline; they bleed and suppurate freely.

Treatment.—In the case of ulceration about the anus the treatment must be that suitable for tertiary lesions elsewhere (see Part I., p. 235) combined with the local use of calomel and starch powder (*vide supra*), or smearing the parts over with white precipitate ointment.

When the ulceration occurs inside the bowel, general anti-syphilitic treatment must also be carried out, but, owing to the constant irritation by the fæces, to the spasm of the sphincter retaining the contents of the rectum in contact with the ulcerated surface and the tendency to stricture, the condition will seldom heal without local treatment of an energetic nature.

In quite early cases, where there is no marked contraction, the anus may be dilated and the patient brought rapidly under the influence of iodides and

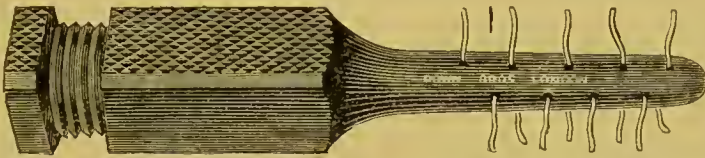


FIG. 10.—RECTAL OINTMENT INTRODUCER. The barrel of the syringe is hollow and the piston is a solid plug which is driven home by a screw movement, forcing out the ointment through the fine holes in the tapering nozzle.

mercury (see Part I., Chap. XII.), the motions kept soft by laxatives, the ulcers kept clean, and the rectum emptied by frequent enemata of boracic lotion or Condyl's fluid, whilst mercurial ointments are applied to the ulcers. A good plan is to use grooved bougies, such as Caspar's, for the purpose. The grooves are filled with mercurial ointment, and the bougies are passed gently and left *in situ* for five or ten minutes so as to keep the ointment well in contact with the ulcerated surface. If preferred, a rectal syringe (see Fig. 10) may be employed. The ointments most used for this purpose are those of white precipitate, dilute nitrate of mercury, or red oxide of mercury. In addition it is well to give some intestinal antiseptic, such as salol or β -naphthol (ten grains, t.d.s.), and the patient should be confined to a couch for a time. This treatment, however, can only be expected to succeed when the case is seen quite early.

When contraction is occurring, the combined ulceration and stricture cause great difficulty, and, although an attempt may be made to overcome the contraction by dilatation, while the other methods of treatment just mentioned are employed, it will soon be found that the dilatation in the neglected cases that are generally met with does harm instead of good, and that it is necessary to perform a temporary colotomy. When this is done, the ulcers can usually be got to heal, the stricture may also be dilated and then finally the colotomy wound may be repaired. Excision of the affected portion of the rectum is not possible in these cases.

In **hereditary syphilis** affections of the anus are very common. They generally take the form of syphilides and mucous patches leading to excoriations and fissures about the anus. If left untreated these little cracks or fissures may develop into deep ulcers and give rise to considerable trouble. Condylomata are also met with in the same situation.

Treatment.—This is practically the same as for hereditary syphilis in general (see Part I., p. 236) combined with the local application of calomel and starch powder (see p. 28).

TUBERCULOSIS OF THE RECTUM AND ANUS.

Tuberculous disease is not uncommon in the ano-rectal region, and it may commence either externally at the anal margin or internally in the mucous membrane or sub-mucous tissues. Primary tuberculosis of the skin around the anus in the form of lupus is sometimes met with in association with lupus of the female external genitals. Sometimes a tuberculous ulcer may develop and spread from the anal margin on to the buttock, presenting all the typical characters of a tuberculous ulcer elsewhere, although the condition is sometimes mistaken for syphilitic or malignant disease. The ulceration may also extend through the anus on to the rectal mucous membrane. The ulcer is generally large and ragged, secreting much pus and only a small quantity of blood, and giving rise to little or no pain on defæcation. The inguinal glands may be affected, and as a rule there is no induration about the base of the ulcer. The progress of the affection is very slow and it is as a rule associated with tuberculous disease elsewhere, very often in the intestines.

When the disease affects the mucous membrane of the rectum just inside the anus, the ulceration is very obstinate and may spread through the rectal wall into the ischio-rectal cellular tissue and give rise to an ischio-rectal abscess.

Treatment.—The treatment of *a tuberculous ulcer about the anus* depends largely on the condition of the patient. When the general health is good and there are no signs of tuberculosis elsewhere, the best plan if possible is to excise the entire ulcer, even when the latter extends into the rectum. This may be done after full dilatation of the sphincter without any necessity for dividing it. If excision of the ulcer involves the removal of a large area of skin, the raw surface may have to be covered by some plastic operation. It is very important to get immediate healing around the anal orifice so as to avoid subsequent contraction. Further away from the anus Thiersch's skin-grafting may be employed. We have had more than one very successful case of this kind, although more than one plastic operation has been required to cover the large surface left after excising all the tuberculous area.

When the patient is feeble and has extensive internal tuberculosis, or when the disease has extended into ischio-rectal fossa, less radical treatment will

be required. Partial excision, scraping or cauterising with pure carbolic or lactic acid or the application of solid nitrate of silver may be tried according to the extent and situation of the ulceration. For pain, an ointment containing iodoform and cocaine is the best.

In the true rectal form of the disease, when the ulcer has not yet penetrated the wall of the bowel, the anus should be fully dilated and the ulcers, if not numerous, thoroughly curetted and cauterised either with the actual cautery or with lactic acid; occasionally dilatation of the anus, followed by the application of a strong solution of lactic acid (20 per cent.) or the introduction of ointments containing iodoform or balsam of Peru by means of a rectal syringe (see Fig. 10) will lead to a cure in the slighter cases. These true rectal cases, however, are very serious and difficult to cure, as the ulcers are very numerous and extensive. We have had a most successful case in which it was necessary to excise the entire lower part of the mucous membrane and sub-mucous tissues of the rectum, as in Whitehead's operation for piles (see Chap. VIII.). By this means a most extensive and intractable condition was perfectly cured.

CHAPTER VI.

PERI-RECTAL INFLAMMATION AND ITS SEQUELÆ.

PERI-PROCTITIS.

INFLAMMATION may spread from the interior of the rectum through its walls into the tissues around, or it may originate in the peri-rectal tissues themselves. We shall here deal with two forms which end in suppuration, namely, diffuse suppurative peri-proctitis (in other words, septic cellulitis of the pelvis) and localised peri-rectal abscess, the so-called ischio-rectal abscess.

DIFFUSE SUPPURATIVE PERI-PROCTITIS.—This generally follows infection from the rectum but may occasionally arise without any injury or proctitis in alcoholics or diabetics, etc.; much more commonly it follows the opening up of the planes of cellular tissue that occurs in injuries or in operations such as excision of the rectum (especially by Kraske's method) or division of a stricture.

The cellulitis commences above the insertion of the levator ani, and may spread into the cellular tissue in the hollow of the sacrum right up to the iliac fossa. The tissues become infiltrated with pus, and sloughing rapidly occurs and, should the patient survive, widespread necrosis of the tissues in the pelvis follows. Usually, however, death occurs from septicæmia or pyæmia with metastatic abscesses in the liver. The disease usually sets in very early after an operation, sometimes the same evening, and is accompanied by high temperature, delirium and vomiting. The wound becomes extremely foetid and greyish in appearance and the pus is sanious, while the patient gradually falls into the typhoid condition, death occurring in from three to ten days.

This form is closely allied to the idiopathic gangrenous peri-proctitis described by Mr. Furneaux Jordan.¹ Both are very rare.

Treatment.—Nothing is of much avail when once diffuse peri-proctitis has set in, and therefore every effort must be made to obtain asepsis in

¹ *British Medical Journal*, 1879, Vol. I., p. 73.

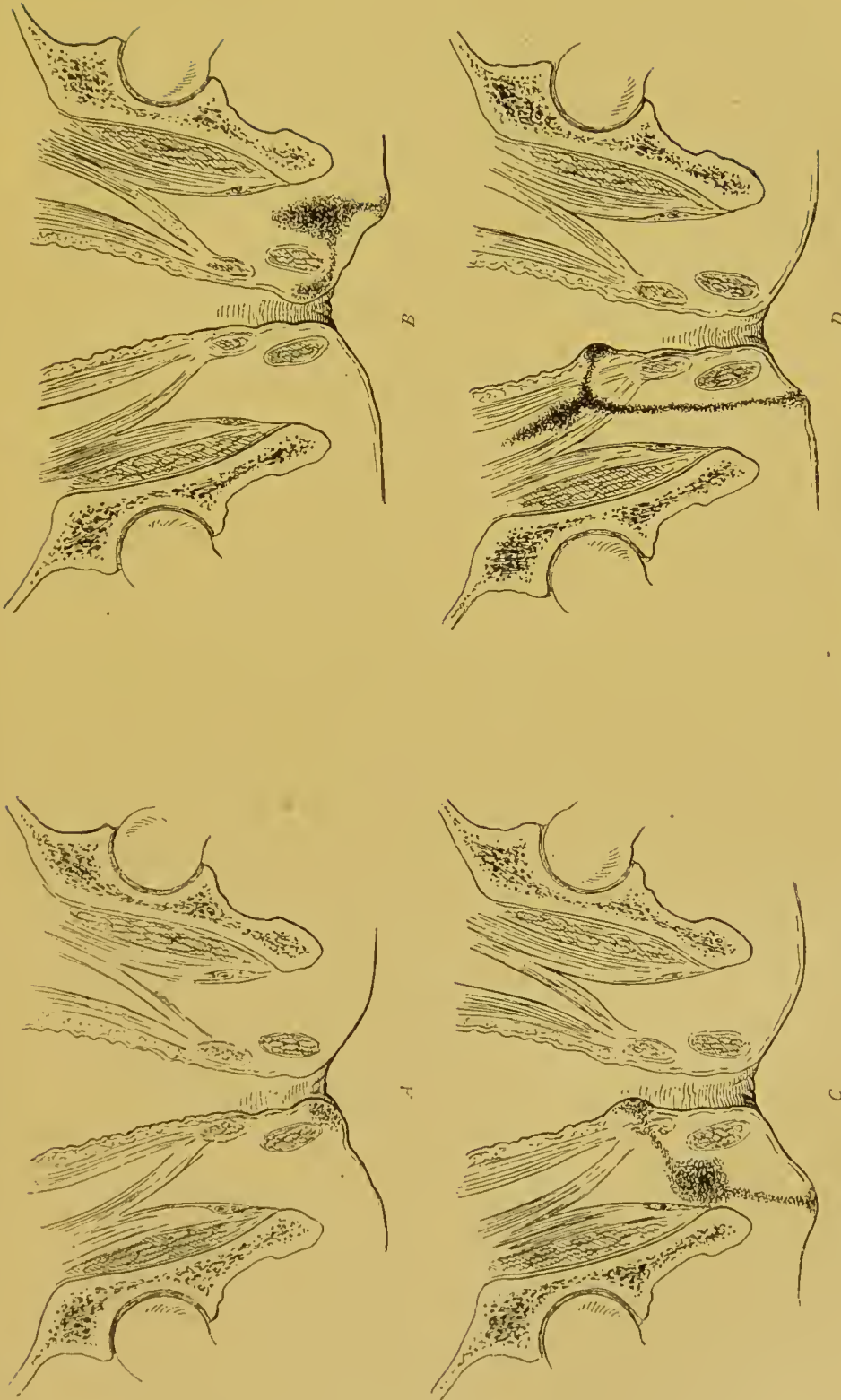


FIG. 11.—DIAGRAMS TO ILLUSTRATE THE VARIETIES OF ISCHIO-RECTAL ABSCESS. *A* shows the simplest form, just beneath the skin at the anal margin. In *B* the abscess is situated in the ischio-rectal fossa, and has found its way thence below the external sphincter into the bowel and also directly downwards to the skin. In *C* the abscess is in the same situation but a little higher up, and has found its way into the bowel through the internal sphincter and also to the skin of the buttock. In *D* the abscess has made its way from above the levator ani through that muscle to the skin and into the bowel above the internal sphincter.

operations upon the rectum—a point that will be referred to fully in connection with excision of the rectum (see Chap. X.).

The condition when once established must be treated on the lines applicable to diffuse cellulitis elsewhere (see Part I., p. 29). The wound must be laid freely open and copious irrigation practised or, better still, the patient may be kept in a warm bath. Injections of anti-streptococcic serum may be employed but, as the condition is often complicated with infection by the bacillus coli communis, the serum is frequently powerless.

ISCHIO-RECTAL ABSCESS.—This condition is far more common than the last and the abscess may occur in various situations, the two important ones being below, and above the level of the levator ani respectively (see Fig. 11). Suppuration is generally due to infection from the rectum and may follow ulcers, fissures, piles, growths, scybala, foreign bodies, strictures, or injuries. There are three chief ways in which the abscess may form, namely, 1. by direct extension from a wound or injury of the mucous membrane; 2. from suppurative phlebitis; and 3. as a result of septic lymphangitis.

1. Ischio-rectal abscess superficial to the levator ani.—More than one variety may be met with. The common form is a small superficial abscess just outside the anal margin and probably originating in the glands of that region. The pus burrows beneath the anal mucous membrane, and perforation may occur there as well as on the skin externally, the result being the formation of a small superficial fistula.

In other cases the abscess is situated well beneath the mucous membrane covering the internal sphincter, and probably results from the septic thrombosis of a pile. Here the pus either bursts into the bowel and gives rise to the so-called "blind internal fistula," or it may find its way down in the sub-mucous tissue and turn round the lower edge of the sphincter into the ischio-rectal cellular tissue, where it forms a true ischio-rectal abscess with an extension upwards beneath the mucous membrane of the rectum. Perforation of the mucous membrane usually occurs comparatively early and then an external opening also forms, giving rise to the ordinary fistula in ano. The swelling and the external opening usually occur in the lateral region of the anus, whilst the internal orifice is generally more posterior.

Another variety, fortunately a rare one, results from septic lymphangitis in the ischio-rectal fossa. This form is more deeply seated and gives rise to swelling both in the ischio-rectal region and beneath the mucous membrane over the upper part of the internal sphincter. Ultimately the abscess bursts both internally and externally and may burrow widely in the ischio-rectal fossa, often opening far out upon the skin of the buttocks and communicating with the internal orifice by a long and tortuous canal. In cases left untreated fresh abscesses may form, so that eventually there are a number of fistulous openings in the ischio-rectal fossa or on the buttocks which usually converge to a single track opening into the rectum.

2. Ischio-rectal abscess situated above the levator ani.—An abscess of this kind may arise either in the peri-rectal cellular tissue itself or may extend from stricture or cancer of the rectum or some disease of neighbouring strictures, such as the cæcum, the broad ligament, the prostate, etc. It is usually accompanied by fever, anorexia, and severe deep-seated throbbing, with difficulty in defæcation. The abscess burrows and may burst in various directions, generally into the bowel above the levator ani, and also through the latter into the ischio-rectal fossa, the skin over which it finally perforates, so that there is an external opening leading to a track which passes first through the levator ani and then into the rectum.

Tuberculous ischio-rectal abscesses are not accompanied by symptoms as severe as those of the ordinary acute variety, and may even rupture without having caused the patient any discomfort.

Treatment.—An ischio-rectal abscess should be freely opened as soon as its presence is detected, in order to avoid the risk of a fistula in ano following; applying poultices or fomentations only wastes time and allows extension of the disease and makes the formation of a fistula almost certain.



FIG. 12.—BRODIE'S FLEXIBLE PROBE-DIRECTOR.

The incision into the ischio-rectal fossa in all cases should be made in a line radiating from the anus and, when the abscess is deep-seated, the incision should be kept as near as possible to the middle line so as to avoid dividing important structures. In a superficial abscess the pus is reached immediately the skin is divided; in the deeper-seated ones Hilton's method (see Part I., p. 27) may be employed, a finger being placed in the rectum to prevent the risk of the forceps penetrating the bowel.

In the ordinary ischio-rectal abscess the pus is very superficial and has so thinned the mucous membrane just inside the anus that it will give way even after the abscess is freely laid open by an external incision, and a second operation for fistula in ano will thus be required. Hence, when it is found on opening one of these abscesses that the pus has burrowed around the lower edge of the sphincter and then up beneath the mucous membrane of the rectum, the best plan is to introduce a probe-pointed, flexible director (see Fig. 12) from the opening in the skin to the highest point of the cul-de-sac beneath the rectal mucous membrane, and to push the director through into the bowel, hook the point of it out through the anus, and then to divide the bridge of tissue lying upon it. In other words, this is a combination of opening the abscess and slitting up a fistula in ano. The cavity is packed and treated just as an ordinary fistula in ano (see p. 37). This radical treatment is only called for when the pus burrows round the edge of

the sphincter and not when it perforates that structure ; here it is worth while to wait and see whether the mucous membrane will recover after free evacuation of the pus by an incision external to the anus.

In the deeper-seated forms, whether they find their way down from above the levator ani or not, the abscess cavity should be opened by an external incision, all diverticula opened up, and a large drainage tube inserted. The bowels should be freely opened before the operation, if possible, and then should be confined for two or three days, after which they should be kept open with laxatives. At each action it is important to fix the dressing with a bandage so as to prevent fæcal material actually passing into the abscess cavity. As soon as defæcation is over the dirty dressings are removed, the parts washed with a 1-2000 sublimate solution, and a fresh dressing of cyanide gauze, sprinkled with iodoform, is packed between the edges of the incision, salicylic wool is placed outside, and the whole is fixed on with a T-bandage.

Many of these deeply seated abscesses will heal without perforating the bowel if free drainage be provided before the mucous membrane has become much thinned. Of course if the abscess be merely secondary to some other disease the sinus left will not heal until the original focus disappears, nor will it heal if a fistula forms through the mucous surface.

FISTULA IN ANO.

By this term is understood a fistulous track, one end of which opens upon the skin and the other into the rectum or the anus. The term, qualified by the adjective "blind," is also used when there is only an external or an internal opening, and when the case is really a sinus and not a true fistula.

Fistula in ano is always preceded by an ischio-rectal abscess, and generally follows its spontaneous opening. It may be simple or tuberculous in nature, and the exact condition of affairs varies widely ; the commonest is a track lined with granulation tissue, outside which is a wall of dense fibrous tissue. The track may lead direct from the internal to the external opening, or it may be very tortuous or have various ramifications, or, again, there may be several external openings all converging to a single internal one.

A fistula once formed has no tendency to heal spontaneously. This is due to several causes, of which the principal are movement of the parts during defæcation and walking, the sluggish venous circulation about the hæmorrhoidal region, and, more important than all, the frequent entrance of the contents of the bowel into a tortuous and narrow track. When the fistula is tuberculous in nature this is an additional hindrance to healing.

The existence of a fistula in ano is easily demonstrated with a probe ; but, before introducing the latter into the external opening, it is very important to pass the finger into the bowel and to search for the internal orifice, which can often be detected either as a small depression, or, more usually, as a slight projection from the mucous membrane. The probe can

then generally be gently manipulated along the canal until it emerges from this opening. Unless this precaution be taken, it is quite easy to push the probe through the mucous membrane at some other spot, and this may be mistaken for the true internal opening when an operation is performed and a portion of the track may thus escape proper treatment; this is of the greatest practical importance.

TREATMENT.—Whenever it is possible, which will be in the large majority of cases, the fistulous track should be laid open from its external to its internal opening. This treatment should always be carried out in the slight muco-cutaneous varieties to which allusion has been made (see p. 34), and also in the ordinary form in which the fistula does not penetrate the sphincter but passes below its lower edge and then burrows up beneath the rectal mucous membrane. The operation is done as follows:

The rectum is emptied by a purgative administered over night and the bowels are washed out by a large warm-water enema three or four hours before the operation. It is best not to give the enema immediately before the operation, because the bowels may continue to act and the manipulations will be much hampered by liquid material escaping. Even if this does not happen, a similar trouble may occur immediately after the operation and the dressings may be much soiled.

The perineum should be shaved and the operation should always be done under general anæsthesia. Gas does not, as a rule, give sufficient relaxation, nor does the anæsthesia last long enough for a proper examination of the fistulous track to be made. The patient is placed in the lithotomy position with the buttocks well raised on a pillow, and the first step is to dilate the sphincters (see p. 6). The mucous membrane of the lower end of the rectum is everted and irrigated, and the internal opening of the fistula is identified either by inspection or palpation, and a Brodie's flexible probe-director (see Fig. 12) is passed into the external opening and made to emerge through it. When the point emerges through the internal opening it is hooked forward with the forefinger and pulled out through the anus, so that a bridge of soft parts lies across it; this is divided with a knife or scissors from the groove in the director until the latter is free. If a Brodie's probe be not at hand an ordinary probe may be passed through and its point hooked out through the anus in a similar manner. The bridge of soft parts may then be divided by cutting down upon the probe until the latter is cut out.

The next point, after having stopped any bleeding, is to examine the cut surface carefully to see whether the entire fistula has been laid open or whether there are diverticula. A careful examination is made both by inspection and by the probe, and any undermined mucous membrane is slit up with scissors and any diverticulum is followed up with the probe and laid well open. Finally, the sinus is scraped with a sharp spoon, or, if the walls be very indurated, the whole track may be excised, after which the surface is sponged with a solution of chloride of zinc (grs. 40 to the oz.) and sprinkled with iodoform. Strips of iodoformed gauze are finally laid in so as to prevent

the edges of the incision coming together, a $\frac{1}{2}$ -grain morphine suppository is introduced into the rectum, and a pad of cyanide gauze and salicylic wool is fixed on with a T-bandage.

When put back to bed the patient should have the legs tied together with a small pillow between the knees, so as to keep the parts at rest as much as possible. A dose of opium should be given the same night both to relieve the pain and to produce constipation, and this may be repeated if necessary. The external dressings should be changed the day following the operation and the buttocks washed with a 1-2000 sublimate solution. The plug, however, need not be disturbed; a fresh external dressing is merely applied.¹ The plug will generally remain *in situ* until the bowels act, which should be on the third or fourth day, after the administration of a dose of castor oil over night. It is well to give a soap and water enema immediately before the bowels are going to act, and, in giving this, care must be taken in introducing the nozzle of the syringe to press it against the sound side of the rectum. The injection of an ounce or more of olive oil just inside the anus also makes the action easier. During defæcation the plug is expelled, and after it the parts should be syringed clean and a fresh iodoformed plug introduced, which should now be changed once or twice a day according to whether it becomes much soiled.

When changing the plug the forefinger should be well oiled and introduced into the rectum, so as to ascertain that the fresh plug lies properly in place, and a probe passed along the track, so as to make sure that there is no tendency at any point for the surface to close over and to re-form the fistula. Unless great care be employed it is quite possible for healing to occur at the surface before the wound has granulated from the bottom and for the fistula therefore to re-form. In about a fortnight's time granulation is so far advanced that there is little chance of the edges growing together, and the plugging may then be discontinued, the patient merely wearing a small perineal pad until the wound has healed. In simple cases this will take about four weeks.

When there are multiple external openings, a probe should be passed from the external orifice nearest to that opening into the bowel and the fistula slit up along it, after which each of the remaining branches should be laid fully open from the original track to the skin opening. This procedure gives rise to the minimum amount of interference with the sphincters, and there is little risk of injuring nerves or other important structures. After the track has been slit up it should be scraped and plugged as recommended above.

The above methods are applicable to the great majority of fistulæ met with in practice, but the difficult cases are those in which the track, instead of turning up around the inferior margin of the sphincter, either penetrates it or

¹ Retention of urine may follow this and other operations upon the rectum. There is very often some tendency to this condition which may sometimes be obviated by allowing the patient to micturate on the hands and knees. If this fail a soft red rubber catheter must be used and may be required for two or three days. Strict asepsis is necessary.

enters the bowel above it, and this is particularly likely to be the case when the fistula runs from the skin of the buttock through an opening in the levator ani into the rectum higher up. Here division of the fistula as above described of course involves division of both sphincters. This means an extensive operation with much bleeding and a long recovery under treatment by packing. In all probability also it will involve incompetence of the sphincters and incontinence of fæces afterwards—a very distressing condition which must be avoided if possible. Nevertheless, the fistula will not heal without complete division, and, therefore, an extensive operation is essential for a radical cure.

When the patient is able and willing to undergo operation, excision of the fistulous track is probably the best procedure. This is done as follows: The patient is put into the lithotomy position and the sphincters are fully dilated (see p. 6). A probe is passed along the fistula into the rectum

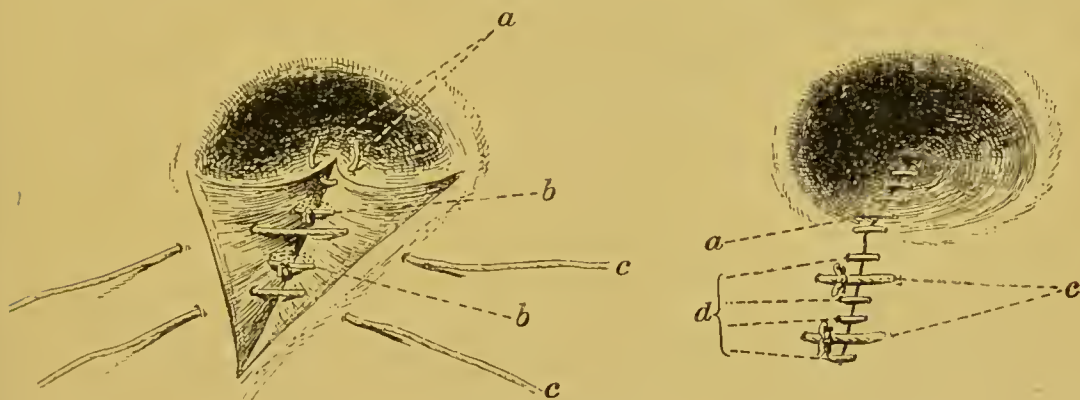


FIG. 13.—DIAGRAM TO ILLUSTRATE THE METHOD OF SUTURING AFTER EXCISION OF A FISTULA IN ANO. In *A* the fistulous track has been laid open into the bowel and entirely excised. The rectal mucous membrane is united by one series of sutures, *a*; the deep surfaces of the wound by a set of buried stitches, *b*; while the rest of the wound is brought together by deep silkworm gut sutures, *c*. In *B* the wound is approximated. The sutures are the same as in *A*, except that an additional set, *d*, is shown, approximating the skin edges.

and the tissues are slit up upon it in the ordinary way (see p. 37), leaving a large gap into the bowel. Diverticula from the main track are then looked for and slit up until the entire fistulous area is laid open. The bleeding points are then secured and the lining wall of the sinuses is seized in catch forceps and completely dissected out preferably with scissors. The dense fibrous wall usually strips up easily from the loose cellular tissue in the ischio-rectal fossa. Great care must be taken not to leave any portions of the fistulous track behind, and the mucous membrane at the internal orifice must be trimmed so as to leave a firm surface for union. The raw surfaces are now brought together so as to secure primary union. Interrupted catgut sutures are first introduced through the divided edges of the rectal mucous membrane so as to slightly invert the mucous membrane towards the lumen of the bowel (see Fig. 13). These sutures are easily inserted by means of fully curved Hagedorn needles, and in the first place only the upper two or three should be inserted and tied

(which can be easily done from the interior of the bowel), and then a few buried catgut sutures should be passed between corresponding points in the deeper parts of the wound so as to bring them well together. When the sides of the gap in the soft parts have thus been more or less approximated, the suture of the mucous membrane of the bowel is completed down to the anus, care being taken to bring the divided edges of the sphincter accurately together, and then the approximation of the deeper surfaces of the wound is completed by passing two or three stout silkworm gut sutures very deeply through the ischio-rectal fossa by means of large curved perineal needles; these may be either tied separately in the ordinary way or over a quill or a button (see Fig. 13). Lastly, the skin incision is accurately united by interrupted silkworm gut or horsehair sutures and a $\frac{1}{2}$ -grain morphine suppository is introduced into the rectum and ordinary gauze dressings are applied externally.

After the operation the bowels must be kept confined for four or five days, after which they should be opened by suitable aperients every alternate day for the first fortnight, and after that laxatives may be given in order to make them act daily. The sutures in the mucous membrane become absorbed and do not require removal. Any cutaneous suture that shows redness around the track should be removed and, if any portion of the wound fails to unite externally, the aperture left should be lightly stuffed with gauze in the usual manner.

This operation, if carefully done, gives a very satisfactory result. If the raw surfaces be accurately sutured, complete primary union frequently occurs and the patient is well in two or three weeks' time. Even when failure of union occurs in parts it is usual for the sphincter to unite by first intention, leaving only a small gap to heal by granulation. This method is really the only alternative to palliative treatment and must entirely replace the free division of the sphincter by the old method followed by granulation from the bottom, as some incontinence of fæces is almost certain to follow.

An operation of this kind would of course also be applicable to fistulæ forming above a simple stricture of the rectum, but when the fistula complicates a malignant stricture, nothing can be done beyond seeing that the external opening is kept free so as to avoid accumulation of infective material along the track. In *tuberculous fistulæ* it is often advisable to make an attempt at radical cure. When the fistula is situated low down, free division of the track followed by complete removal of its walls and allowing the wound to heal by granulation from the bottom may suffice, but in the majority of cases it is essential to aim at healing by first intention, and therefore the operation last described will be the best treatment.

Should the fistula be extensive and complicated by numerous tortuous sinuses, or should the patient be in bad health or in the last stages of phthisis, palliative treatment alone should be undertaken. The best procedure is to see that the track is properly drained so that there is no accumulation of infective material in it to give rise to fresh abscesses. The best way to insure

this is to dilate or incise the external opening and then to dilate the track right up to the bowel. The sinus is then thoroughly scraped and packed from the bottom and the bowels are so regulated that fæces do not accumulate, and it may happen in rare instances that the fistula heals completely. In any case the discharge will diminish and the patient will be much more comfortable, while at the same time he does not run much risk of extensive burrowing of pus. This method however can only be looked upon as a palliative measure to be employed under exceptional circumstances.

When the fistula passes through the levator ani but is not connected with the rectum, the only treatment, as far as the fistulous track itself is concerned, is to lay it freely open, to enlarge the opening through the levator ani, to scrape its walls and to insure proper drainage. If the sinus lead to bare bone in the pelvis, an attempt may be made to treat it appropriately. Should it run to the prostate or to the broad ligament, etc., the primary cause must be dealt with according to circumstances. The patient should in all cases be kept in bed until the deeper part of the wound has healed, and the bowels should be regulated on the lines already laid down for an ordinary fistula in ano.

CHAPTER VII.

FISSURE IN ANO: ECZEMA AND PRURITUS ANI.

FISSURE IN ANO.

By this term is understood a small crack or fissure lying just within the sphincter and extending from the muco-cutaneous margin upwards for a short distance. It occurs more commonly in women than in men and causes extreme suffering, although the lesion itself is usually trifling. The fissure is generally situated about the posterior commissure of the anus, and it is generally possible, by slightly separating the buttocks, to see the lower end of the minute slit, which is usually quite shallow although it may occasionally extend down to the fibres of the external sphincter. At the lower end of the fissure there is generally a small projecting tag of mucous membrane which is often called a "sentinel pile."

A fissure may arise in various ways. Probably the most common mode of origin is that described by Dr. Ball, namely, a mechanical detachment of a small piece of the mucous membrane in the act of passing hard fæces; this is torn downwards and, like the somewhat corresponding condition about the finger nails, causes intense pain. A fissure may also result from some injury, and is not at all uncommon as a result of a superficial syphilitic ulceration.

SYMPTOMS.—The symptoms are very characteristic. There is an intense cutting or burning pain during the act of defæcation, lasting for some time after the act. When once the pain passes off, the patient is free until the next time the bowels are moved, and in consequence the action is deferred as long as possible, and then the scybalous masses give rise to increased agony. Sometimes the motions are slightly streaked with blood, but there is never any of the free hæmorrhage characteristic of piles. On examining the patient, the most obvious condition is spasm of the sphincter, which is increased at the slightest touch, so that it is practically impossible to pass the finger through the anus, and no attempt should be made to do so without a general anæsthetic. On separating the buttocks the sentinel

pile can generally be seen and, by pulling aside the anal folds, the lower edge of the ulcer comes into view; even without seeing this, however, the condition is so characteristic that no mistake should be made in the diagnosis.

TREATMENT.—The best plan is to administer a general anæsthetic, to dilate the anus and insert a large speculum, to snip off the sentinel pile and to carry a knife through the base of the ulcer for about an eighth of an inch down to the external sphincter, but not through more than its most superficial fibres; the operation should be done with the patient in the lithotomy position. If the fissure be of long standing and much indurated, its surface may be scraped. A half-grain morphine suppository should be introduced into the rectum, a little iodoform dusted on the wound, and the bowels kept confined for a few days, after which they are opened daily by a laxative; as a rule the cure is complete. Simple stretching of the anus may suffice for a cure, but it is uncertain.

Occasionally the patient refuses operation, and *palliative treatment* must be tried. This is most likely to result in a cure when there is no sentinel pile at the bottom of the fissure and when the latter is only recent and has no indurated edges. The bowels should be kept open daily by the administration of confection of senna (3i) or equal parts of confection of senna and sulphur (āā ʒss) every night, and the action of this may be reinforced by a mineral water taken early in the morning. Immediately after the bowels have acted, the parts should be carefully washed with warm water, soap, and a soft sponge, and an ointment containing ten grains of cocaine, two drachms of sub-nitrate of bismuth, and half a drachm of iodoform to the ounce of vaseline should be injected within the sphincter by means of a special ointment introducer (see Fig. 10). If there be much pruritus, extract of belladonna thickly smeared over the anus is also useful. If the fissure prove sluggish, an attempt may be made to promote healing, painting it with a solution of nitrate of silver (two or three drachms to the ounce); in recent cases this method of treatment will often produce satisfactory results. It is, however, hardly ever worth while to employ palliative treatment in preference to operative measures, as the time and trouble spent by the patient and the pain he must necessarily undergo are far greater than if an operation were undertaken.

Should the fissure be in connection with a mucous patch of syphilitic origin, the patient must first of all be put on anti-syphilitic treatment and, if this be combined with the palliative measures already spoken of, the fissure will often heal, unless it has existed a long time; should it refuse to heal, the ordinary operative measures (*vide supra*) should be undertaken.

“Irritable ulcer of the anus.”—This is a condition distinct from the ordinary fissure in ano, and probably arises from the irritation of hardened fæces as they rest against the mucous membrane of the rectum on the shelf formed by the top of the internal sphincter. It is often associated with piles, and there is as a rule not so much spasm of the sphincter as in the cases

just described. The pain, although most marked on defæcation, is also frequently present in the intervals.

The treatment should consist in dividing the ulcer and scraping its surface, just as for a fissure in ano (*vide supra*).

ECZEMA ANI.

Chronic eczema of the anus is not uncommon when there is some cause of irritation about the anus, such as fissures, piles, worms, acrid discharges, or want of cleanliness. The eczematous condition causes intolerable itching, and the patient scratches the part and increases the trouble, so that in bad cases it is almost impossible to sit, walk, or lie down in comfort.

Treatment.—The cause must of course be removed before anything else is done. Fissures should be treated, piles removed, or worms got rid of, and the parts kept clean. They should be well washed with warm water and superfatted soap two or three times a day, and this should be followed by irrigation with warm boracic lotion. The parts should then be thoroughly dried by dabbing them over carefully with a soft bath-towel—they must not on any account be rubbed dry—after which a dusting powder of equal parts of boracic acid and oxide of zinc is applied, and a piece of boracic lint placed between the buttocks and fixed on with a T-bandage. When there are acrid discharges, a lotion of carbonate of soda may be employed in place of the boracic lotion; when the condition is chronic and there is much thickening of the parts, 10% ichthyol ointment is often very valuable.

PRURITUS ANI.

This is a most troublesome condition which may or may not be associated with the previous one and which is characterised by intense itching around the anal orifice and all over the perineum. Amongst the general causes of the affection may be enumerated gout, diabetes and errors in diet, especially overfeeding, whilst occasionally it is of an entirely neurotic origin. Among local causes the most common are constipation, piles, fissure or fistula in ano, whilst it also occurs in subjects of chronic diarrhoea, and may be set up by irritating vaginal discharges, the presence of worms in the rectum, etc. The itching, which is often present without any visible lesion, is sometimes intolerable and is generally most marked on sitting down or going to bed, and scratching aggravates rather than relieves it. After the condition has lasted for some time, the skin about the parts may become indurated, cracked and fissured and marked eczema may be present.

Treatment.—This should be both constitutional and local. Any constitutional disease, such as gout or diabetes must receive appropriate treatment. The diet should be carefully regulated, the amount of nitrogenous food reduced and all highly spiced dishes interdicted. Heavy wines, such as port or Burgundy, should be given up. The parts should be kept clean as in

eczema of the anus (*vide supra*) and suitable saline purgatives should be administered. Local causes, such as thread-worms, leucorrhœa, piles, etc., should be removed and, where no local cause can be found and the boracic lotion proves inefficient, various ointments, particularly 5% oleate of mercury, or 12% chloroform ointment, are useful.

Other useful applications are unguentum plumbi acetatis, containing ten to fifteen grains of cocaine to the ounce, lead lotion or a strong solution of nitrate of silver (a drachm to a drachm and a half to the ounce) painted over the surface every two or three days.

Opium should never be given to control the pain as it causes constipation and increases the irritation. If there be much restlessness, chloral, bromide of ammonium or potassium, sulphonal or trional may be employed. When the skin is hypertrophied the parts may be pencilled with equal parts of carbolic acid and tincture of iodine every other day. If in addition to being hypertrophied the parts are much fissured, the application of the actual cautery may be necessary. This acts by destroying the terminations of the nerves but should only be applied superficially so as not to cause deep ulceration.

COCCYDYNIA has already been described (see Part III., p. 107).

CHAPTER VIII.

HÆMORRHOIDS.

HÆMORRHOIDS, or piles, are varicose enlargements of the terminal branches of the hæmorrhoidal plexus which form compressible swellings beneath the mucous membrane of the lower end of the rectum or the skin around the anal margin. The varicosity generally begins at the junction of the superior with the middle hæmorrhoidal veins whilst the true external piles are caused by dilatation of the inferior hæmorrhoidal branches.

VARIETIES.—Hæmorrhoids are divided into *external* or *internal* piles according to their position relative to the external sphincter. Thus internal piles are situated above, and external piles below it. Frequently however the two varieties merge into one another and hence a third form, the *intero-external* variety, is often described. Another important classification is into *symptomatic* and *idiopathic* piles, the former being secondary to some other affection, which must be relieved before the hæmorrhoidal swellings will disappear. Any interference with the portal circulation for example, such as occurs in cirrhosis or malignant disease of the liver, may cause distension of these veins and the production of piles. Similarly cancer of the rectum, stricture of the rectum or urethra, enlarged prostate, various uterine disorders and certain forms of heart disease may all produce hæmorrhoids, which although they give the patient much discomfort are not of primary importance and cannot be remedied unless the original cause can be removed. The idiopathic piles are most frequently met with; they are common in middle life but rare under twenty years of age, and generally commence about the age of twenty-five when an active athletic life is exchanged for a sedentary one. The affection is as common in men as in women; in the latter pregnancy is a strong predisposing cause.

CAUSES.—Heredity, race and climate are said to influence the production of piles; oriental races and dwellers in hot climates for instance are said to be more readily affected than those living in more temperate climates. Diet undoubtedly plays an important part; heavy feeders not only suffer from engorgement of the portal circulation and consequent congestion of the

hæmorrhoidal veins, but in them there is also direct irritation of the rectal mucous membrane by various articles of diet. Constipation is also of the very highest importance in the etiology ; it does not act so much by direct pressure on the veins as by leading to ineffectual straining at stool, which causes temporary pressure on the veins and congestion of the part. Prolonged straining at stool is also likely to be followed by slight damage to the anal mucous membrane which in its turn gives rise to a certain amount of phlebitis and vaso-motor congestion of the parts, and thus brings about the formation of the true hæmorrhoid.

SYMPTOMS.—The symptoms may be classified according as the patient suffers, 1. from an ordinary uncomplicated attack of piles, or, 2. from an exacerbation of the ordinary symptoms, usually spoken of as an “acute attack of piles.” In the latter case the patient may have so little trouble between the attacks that he requires no treatment and does not even know that he suffers from hæmorrhoids. In other cases, generally after two or three of these acute attacks, the piles remain permanently in evidence, and the patient therefore suffers from the symptoms due to an ordinary uncomplicated attack of piles with occasional exacerbations.

In an ordinary uncomplicated case of piles, the patient is usually conscious of uneasiness, irritation, or itching about the anus, around which are soft compressible swellings which become turgid during defæcation. The pain is only quite slight and of a dull aching character. Should the patient suffer from internal piles alone, the pain is usually only present when the tumours are protruded through the anus and disappears entirely when they are returned within it. External piles are soft, fleshy masses situated around the margin of the anus within which they cannot be reduced and they do not bleed, although there are often cracks and fissures in the mucous membrane between them. Internal hæmorrhoids on the other hand are not visible unless they are extruded by straining or unless the patient suffers from a so-called “acute attack” of piles. They bleed freely, often on the slightest touch, and the blood is generally arterial in character, but it may be venous. Bleeding usually only occurs during the act of defæcation, and the blood spurts over the pan in a very characteristic manner. This blood comes from the surface of the pile in the form of a capillary oozing ; occasionally there may be a minute opening into one of the large venous spaces, and most serious and even fatal hæmorrhage may occur. In these particular cases, and also when the piles are inflamed and protruding through the anus, bleeding may occur independently of defæcation. There is always a certain amount of mucous discharge and considerable pruritus.

In an acute attack of piles there is a condition of acute inflammation, practically phlebitis and peri-phlebitis. This usually complicates the internal variety of piles and may lead to complete thrombosis of the veins forming the piles affected. Far from curing the pile, this merely produces induration in it and often renders it more prominent in the quiescent intervals, and therefore more likely to be the seat of fresh acute attacks, as it becomes

chronically œdematous and thickened. A certain amount of prolapse of the rectum may accompany these acute attacks, but it disappears when the piles are removed.

The piles may actually slough, or suppuration may occur in them, in both cases as a result of bacterial infection. It is generally held that the bacillus coli communis is responsible for the phlebitis and thrombosis, while the pyogenic organisms give rise to suppuration and gangrene. In the case of an external pile, thrombosis practically always cures the particular pile affected, which shrivels up and is merely represented by a small skin tag about the anus.

Patients who once develop well-marked piles generally remain subject to them for the rest of their lives. With proper care piles may almost entirely disappear, but they are apt to recur with any error of diet or hygiene. As long as the affection is slight, the patient may be the subject of both internal and external piles without any marked inconvenience so long as he takes proper precautions. When once the tumours have reached any size they constantly come down through the sphincter, and the patient is not only subject to repeated attacks of bleeding but is liable to serious risk from inflammation and its various sequelæ.

TREATMENT OF UNCOMPLICATED CASES.

This may be considered under two heads, namely, palliative and radical treatment.

Prophylactic and palliative treatment.—In a number of cases this is all that is required, the essential points consisting partly in a proper regulation of the alimentary functions and partly in the observance of proper cleanliness. All causes that may interfere with the circulation through the hæmorrhoidal plexus should be avoided, more particularly anything that may produce congestion of the liver. A diet should be adopted which will neither interfere with the functions of the liver nor cause local irritation of the rectum. Alcohol should be taken sparingly, and highly spiced dishes and an excess of nitrogenous food should be forbidden. The greatest care should be taken to avoid constipation, which is probably the most potent cause of piles; this matter is too large to deal with here and a suitable medical text-book should be referred to. It suffices to say that the diet should be light and should contain articles promoting peristalsis, such as ripe fruits, wholemeal bread, stewed prunes, baked apples, figs, etc., and that a very important point is to take means to induce a regular action of the bowels. In addition, some laxative will generally require to be taken regularly; the best are cascara, effervescing sulphate of soda, or an aperient mineral water. A useful plan is to prescribe a dinner pill containing nux vomica, belladonna, and cascara,¹ to be followed by a

¹ A useful formula is: ℞ Ext. nucis vomicæ, gr. $\frac{1}{2}$; ext. cascariæ sagradæ, gr. i; ext. gent., gr. iij; or, ℞ Ferr. sulph. exsicc., gr. i; ext. nuc. vom., gr. $\frac{1}{2}$; ext. belladonnæ, gr. $\frac{1}{2}$; ext. gent., gr. 2.

dose of mineral water in the morning, and the bowels should be encouraged to act at the same time every day. The patient should be told that he should err rather in taking these laxatives for too long than for too short a time.

It is important to avoid straining at stool as there is no greater cause of congestion of the parts. Should the patient find that the bowels are not going to act easily, the attempt should be given up and a larger dose of the aperient taken the next time. A sedentary life must also be corrected as far as possible, and suitable exercise should be prescribed having regard to the requirements of each individual case. A patient who sits for a considerable time during the day should be instructed to use a chair with a hard seat rather than a well-padded one.

Great care must be taken to insure proper cleanliness of the parts and also to avoid accidental injury; the congestion so frequently present renders this very liable to occur. When there is marked swelling, the best plan is to employ careful sponging with warm boracic lotion applied by a pad of wool or a soft sponge, and the patient should be instructed to encourage the act of defæcation just before taking a warm bath in the morning; this is not only valuable for ablutionary purposes but diminishes the swelling and irritation. After defæcation paper should not be employed; the parts should be cleansed with a soft sponge and warm water. If the patient can afford it, a very comfortable plan is to have a hot and cold water douche fitted to the closet. The hot water douche is first employed to cleanse the parts and after that the cold water is turned on and the parts are finally dried with a soft bath towel. After the bath, glycerine of tannic acid, or lead and opium lotion, or one containing iron should be applied to the parts.¹ For the treatment of the bleeding see p. 57.

Radical treatment.—This will vary according as the patient suffers from internal or external piles alone, or the two forms combined, and also according to whether the condition be complicated or not by some inflammatory mischief.

(a) **Of external piles alone.**—It not infrequently happens that the protrusions around the anus are a considerable annoyance to the patient, preventing him from taking horse or bicycle exercise and interfering with proper cleanliness. Moreover, cracks and fissures are very apt to develop and to prove very troublesome. Under these circumstances, it is well to remove the piles, seizing each one with a pair of forceps and nipping them off with a pair of scissors curved upon the flat. The patient should be under a general anæsthetic in the lithotomy position, and care should be taken to make the long axis of the incision radiate in all cases from the anus, so as to avoid the occurrence of stricture subsequently. Each individual wound may be sutured with fine horsehair; any bleeding that occurs is easily arrested either by the sutures or by a pad of boracic lint kept in position by a T-bandage.

¹ The following may be used: ℞. Liq. ferri, 1 part; glycerini, 2 parts; aquæ, 3 parts.

This operation may, if necessary, be done under eucaine anæsthesia; but it is far better to give the patient a general anæsthetic, as the opportunity may be taken to dilate the sphincter and examine for internal piles, which, if necessary, may be removed at the same time (*vide infra*).

If the pile be inflamed and thrombosed very acute pain may be caused, especially when the pile is large, as the parts are so tender that the patient cannot sit, stand, or walk in comfort. The indication is to remove the clot and relieve the tension at once, and this may be done by injecting a few minims of an 8% solution of eucaine into the base of the pile, and then transfixing it with a sharp curved bistoury in a line radiating from the anus, laying it freely open and turning out the clot; the congestion is at once relieved and the pain disappears in a very short time, while there is no bleeding, as the vein is thrombosed. A still better plan is to put the patient under a general anæsthetic and remove the whole pile, clot and all, in the manner recommended above, bringing the edges of the wound together with a suture. There is no objection to doing this, even though there be considerable inflammation about the part. This method has the advantage over mere incision that it gets rid of the skin tags that must otherwise occur, and which, in the case of a large external pile, may enclose a fairly large suppurating cavity, which takes some little time to heal.

The *after-treatment* is very simple. A pad of boracic lint is applied at the time, and in twenty-four hours this is removed and the parts are washed with warm boracic lotion, after which equal parts of iodoform and boracic ointment are applied, and changed two or three times a day. Healing is usually complete within a week.

(b) Of internal piles and of the mixed form.—In ordinary uncomplicated cases it is always advisable to employ operative treatment when the palliative measures mentioned above (see p. 48) do not entirely relieve the symptoms. It is quite common for patients to suffer from piles for years and to persist without operative treatment in the hope that each inflammatory attack from which they suffer may be the last, when they should really be strongly advised to undergo operation.

In favour of operation it may be urged that the length of time that the patient is laid up after it is quite trivial compared with the time lost by the various acute attacks to which these patients are invariably subjected, and which necessitate a considerable period of rest for their treatment. Again, there is no doubt that hæmorrhoids produce a peculiar mental effect upon the patient and give rise to much irritability of temper and nervous depression which disappears entirely immediately after operation, so that the mental relief alone is indeed remarkable. Finally, operation is practically safe and almost painless, and patients are thereby relieved from all danger of attacks of inflammation and strangulation—accidents which are not only excessively painful, but actually dangerous. We should advise, therefore, that operation should be performed in all cases of idiopathic piles where the patient is distinctly suffering, and operation is imperative when the patient is

losing much blood or when the piles come down as the patient walks about, and of course when there are any of the various complications demanding operative treatment (*vide infra*).

Even at the present time there is no universal agreement as to the best method of operative treatment to be employed. The three chief methods in vogue are complete excision of the pile-bearing area, removal of isolated piles by the clamp and cautery, and ligation of the tumours.

Excision.—Of excision of piles it may be said that, from the theoretical point of view, it is clearly the ideal method. By excision the pile area is completely removed and primary union should result. The difficulties lie partly in the anatomical factors and partly in that septic infection cannot always be guarded against, and may interfere with union. The only method of excision which we need consider here is that introduced by Mr. Whitehead of Manchester, and known by his name. In it the lower inch or so of the mucous membrane, together with the terminations of the hæmorrhoidal plexus, is completely removed, this being followed by suture of the cut edges of the mucous membrane to the skin. There can be no doubt as to the theoretical advantages of this method. It is comparatively easy to perform; it is followed, as a rule, by primary union without pain or subsequent inflammation. On the other hand the disadvantages are undeniable, although doubtless these diminish as the operator becomes more practised. Thus considerably more blood is lost in performing it than in using the clamp and cautery, and therefore the procedure may be serious to those who are profoundly anæmic. Again, stricture around the anal orifice has occurred more than once, either as a result of giving way of the sutures or from imperfect suturing at the time of operation, as may occur when too much mucous membrane has been excised and when therefore there is tension on the stitches. As a rule, however, any stricture that may thus form is so narrow that it is easily dilated with the finger or a bougie, or it may be satisfactorily treated by subsequent division. Fatal pyæmia has followed the operation, and pulmonary embolism has also been known to occur. The operation is best suited for vigorous adults in whom there is an extensive and general development of piles. It is unnecessary where only two or three large internal hæmorrhoids are present, or where the chief trouble is external piles.

Whitehead's operation. Mr. Whitehead thus describes his operation:¹

“1. The patient, previously prepared for the operation, and under complete influence of an anæsthetic, is placed on a high narrow table in the lithotomy position, and maintained in this position either by a couple of assistants or by a Clover's crutch.

“2. The sphincters are thoroughly paralysed by digital stretching, and permit the hæmorrhoids and any prolapse there may be to descend without the slightest impediment.

“3. By the use of scissors and dissecting forceps the mucous membrane

¹ See *British Medical Journal*, Feb. 6, 1887.

is divided at its junction with the skin around the entire circumference of the bowel, every irregularity of the skin being carefully followed.

"4. The external and the commencement of the internal sphincter are then exposed by a rapid dissection, and the mucous membrane and the attached hæmorrhoids, thus separated from the sub-mucous bed on which they rest, are pulled bodily down, any decided points of resistance being snipped across, and the hæmorrhoids brought below the margin of the skin.

"5. The mucous membrane above the hæmorrhoids is now divided transversely in successive stages, and the free margin of the severed membrane above is attached as soon as divided to the free margin of the skin below by a suitable number of sutures. The complete ring of pile-bearing mucous membrane is thus removed.

"Bleeding vessels throughout the operation are twisted on division. This brief description comprises the several stages of the operation.

"It is better to commence the separation of the mucous membrane from the skin at the lowest point, and deal with the two sides in succession, before completing the circle above, so that any oozing that may occur shall be below the work as it proceeds. The incisions must be made through the mucous membrane, and not through the skin. It is very important that no skin should be sacrificed, however redundant it may appear to be, as the little tags of superfluous skin soon contract, and eventually cause no further inconvenience. If this precaution be taken, there is no fear of stricture.

"The attachment of the mucous membrane and piles to the sphincters is so slight that I either employ the closed scissors as a raspatory, or use my fingers in their separation. The firmest adhesions are always found at the highest and lowest points, where the fibres of the external sphincter converge. With a very little patience the whole of the hæmorrhoidal plexus can be isolated and the membrane drawn down, leaving the external sphincter almost bare and cleanly dissected. Up to this stage of the operation there is practically no hæmorrhage, for, as is well known, the arteries which supply the rectum run immediately beneath the mucous lining, and not in the loose tissue separating it from the sphincters. These are however necessarily cut in the next step, which consists in the transverse division of the mucous membrane just above the piles. To prevent hæmorrhage, it is advisable to cut through the bowel by degrees, and twist each bleeding vessel as it is divided. After securing the vessels, before making any further incision in the bowel I attach the free edge of the piece of mucous membrane first divided to the corresponding portion of skin at the verge of the anus. The procedure is repeated until the entire circumference of the bowel is secured to the skin. By this means I almost invariably secure healing by first intention. For the purpose of suturing the mucous membrane to the skin, I always employ carbolised silk, and I never take out the stitches, as I find they come away by themselves without creating the needless alarm to the patient which their removal generally occasions. Indeed, after the operation, there is no real necessity ever to look at or touch the parts again.

"Whilst the patient is still on the table, I introduce into the rectum a suppository containing two grains of extract of belladonna, give the external parts a final dust with iodoform, and place over all a strip of oiled lint, which is retained in position by a T-bandage.

"For the first few days, with highly neurotic patients, I keep a bag of ice in close proximity to the rectum, and I generally recommend a dose of castor-oil to be taken on an empty stomach on the morning of the fourth day. The patient sits up on the fourth day, and is in a condition to resume work within a fortnight.

"I rarely find that the patient suffers much pain after the operation, though this depends chiefly on the nervous susceptibility of the individual. Some aching in the back may be complained of, as in other pelvic operations, but this is generally relieved by change of posture. If the change of posture does not answer, a hot water-bag or hot salt applied to the back will generally give immediate relief."

We generally employ about 12 to 16 sutures so as to avoid tension anywhere, and to bring the cut edge of the mucous membrane as accurately as possible into contact with the cut edge of the skin, so to reduce to a minimum any granulation tissue after the operation which might give rise to cicatricial tissue and interfere with the complete success of the operation. The sutures may be of any material. We usually employ catgut and cut the ends an inch or an inch and a half long, so that, should any of the stitches fail to become absorbed or to cut their way out spontaneously, they may be easily identified and can be removed. If the sutures are of non-absorbable material, such as silkworm gut or horsehair, their ends should be left fairly long for subsequent identification. We prefer not to use silk as recommended by Mr. Whitehead, as it is an absorbent of septic material.

Clamp and cautery.—This is a very useful operation in many cases, for it has the advantage of removing the piles completely without the loss of more than a few drops of blood, and is, therefore, applicable to the most anæmic and debilitated subjects. If properly done, there should be little or no pain following it and little or no risk of accidental or secondary hæmorrhage. Neither is a properly performed operation likely to be followed by contraction. It is unsuited for cases of general hæmorrhoidal dilatation where more than four or five piles require removal. In these cases there is practically no alternative to the operation of excision (*vide supra*). The operation by the clamp and cautery is done as follows :

The bowels having been properly evacuated beforehand (see p. 37), the patient should be placed in the exaggerated lithotomy position, the perineum shaved, and the sphincter fully dilated in the usual manner (see p. 6). This dilatation should be most carefully done and five minutes at least should be consumed in effecting it, the muscles being stretched steadily to their utmost limit. The pile-bearing area then prolapses at once and all mucus should be sponged from the surface so that the number of piles requiring removal can be noted and suitable ring forceps (see Fig. 14. A) attached to each one

that it is desired to clamp. The identification and fixation of the piles to be removed should be done before the clamp is applied to the first one, as otherwise the manipulations necessary to secure the piles in the forceps subsequently may tear asunder the eschars already made by the cautery and so provoke bleeding. In the female the identification of the piles can be greatly facilitated by introducing a finger into the vagina and pressing the anterior wall of the rectum forcibly backwards.

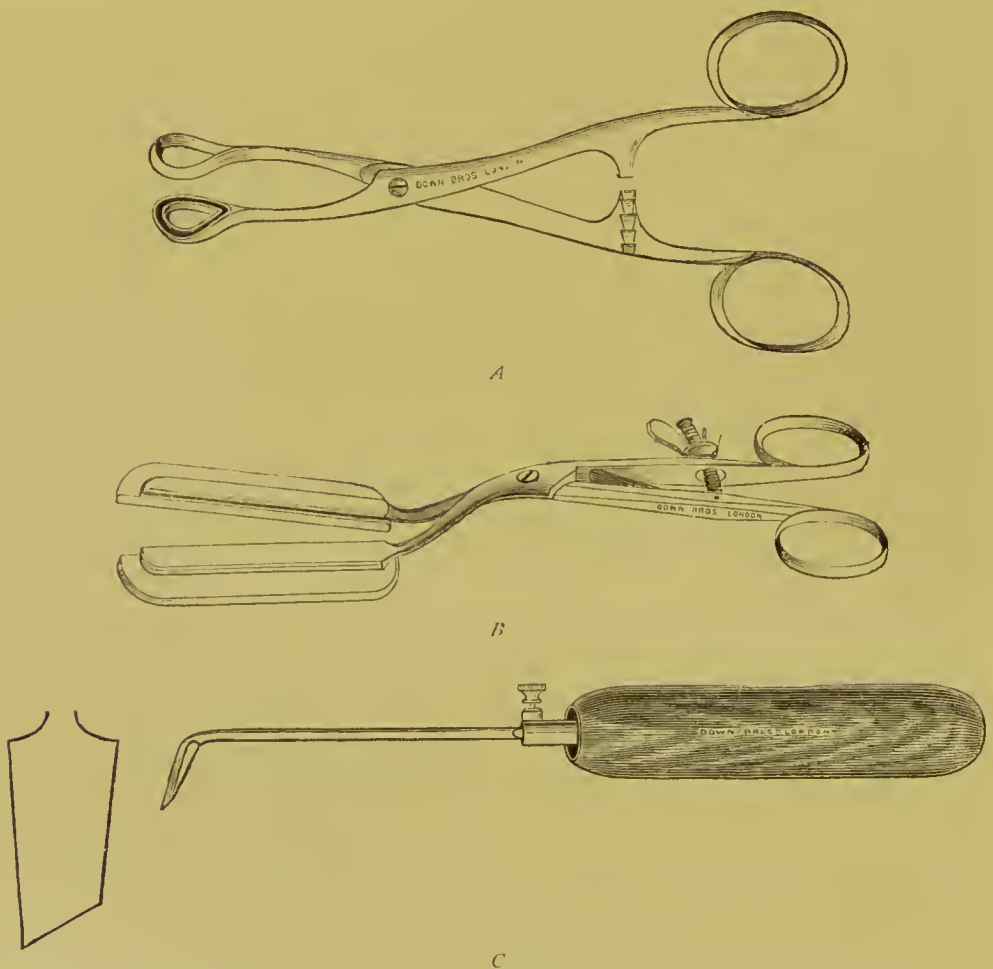


FIG. 14.—INSTRUMENTS FOR THE CLAMP AND CAUTERY OPERATION FOR PILES. *A*, ring forceps; *B*, Smith's clamp; *C*, cautery, with air-jacket round handle to prevent over-heating.

The clamp is now applied to the first pile to be removed in such a manner that its long axis is parallel to that of the bowel, a most important point, the neglect of which may lead to serious contraction subsequently. The clamp employed (see Fig. 14. *B*) should have a powerful screw, and care must be taken in applying it to see that the entire pile is within the grasp of the blades, as, if carelessly applied, a portion of the hæmorrhoid may project beyond the end of the instrument and this is a prolific source of troublesome bleeding. The clamp is now screwed up tight and the cautery is applied.

Before this is done it is well to smear the buttocks thickly with vaseline or some ordinary ointment so as to prevent scorching from the proximity of the cautery, and we have found it a good plan in addition to surround the parts with a towel which still further protects the skin of the buttocks. A cautery of suitable shape (see Fig. 14. C) is then applied at a dull red heat and made to sear off the pile gradually (see Fig. 15). It is best not to snip off the portion of the pile projecting beyond the clamp before applying

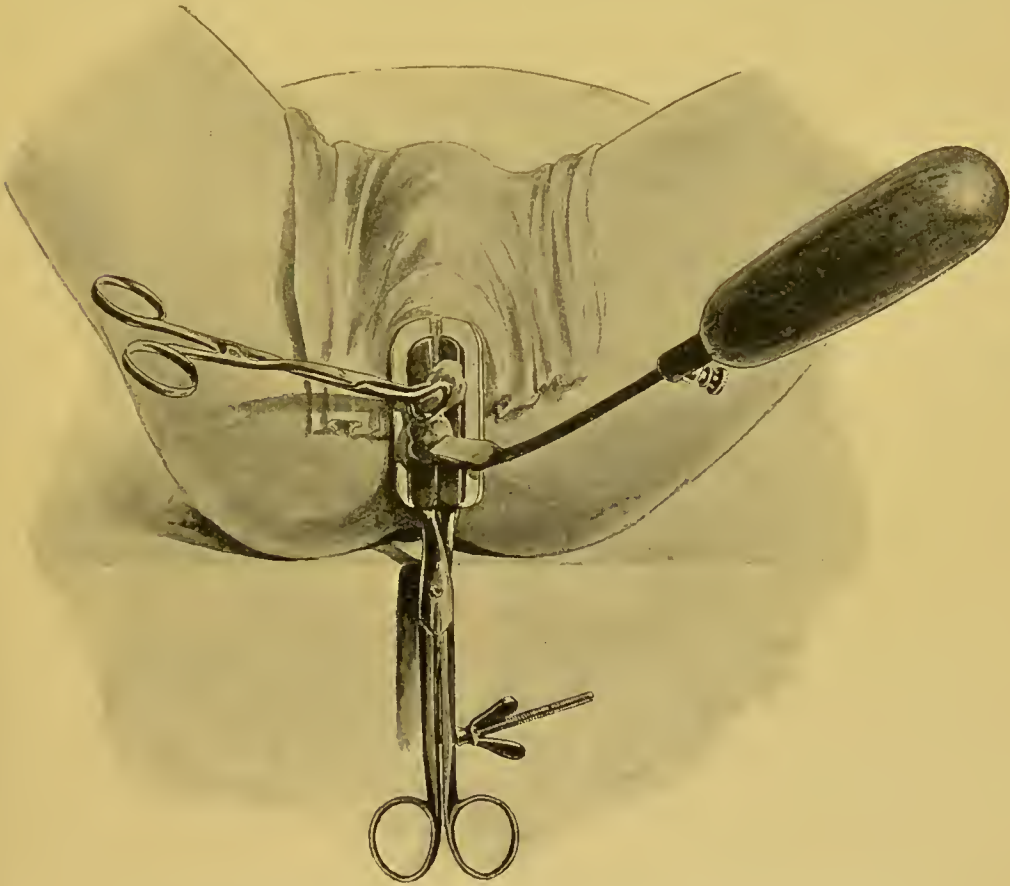


FIG 15.—THE CLAMP AND CAUTERY OPERATION FOR PILES. The figure shows the method of searing off the pile after it has been pulled down by the ring forceps and secured in the clamp. The parts are protected from the heat of the cautery by a towel thrown over them.

the cautery, as is sometimes done; by searing off the whole mass a thicker eschar is obtained and bleeding is more effectually guarded against. When the projecting portion of the pile has been burnt off, the seared surface is dried and a second cautery at a very low red heat is rubbed well over it. This should be done slowly and thoroughly so as to obtain the thickest possible eschar and is the best preventive against bleeding. A Paquelin cautery is unsuitable for this operation, as it is very difficult to keep it at the low heat that is required. If a cautery be used hotter than at a dull red heat it cuts like a knife, does not sear the vessels properly, and there may be troublesome hæmorrhage when the clamp is relaxed. We always heat our cauteries in an ordinary fire or at the flame of a Bunsen lamp if available.

After the surface has been thus thoroughly seared, the screw of the clamp is gradually relaxed and the blades are slowly separated so as to allow the base of the pile to escape piece by piece. Should there be any sign of bleeding, the blades can be pressed together again at once and a fresh cautery applied. If however the original cauterisation has been efficient, there should be no necessity for this. Each of the remaining piles is now removed in turn in a similar manner, and it is important to note that care should be taken not to include the skin around the anus within the blades of the clamp, as otherwise considerable pain is likely to result.

After all the internal piles have been removed, attention is turned to the external ones, which are best treated by picking them up with forceps and snipping them off with a pair of scissors curved upon the flat. The scissors should be applied in a line radiating from the anus, and care must be taken to remove not only the skin but the projecting venous mass beneath it as well. Any bleeding from this source readily stops on pressure, and it is well to insert catgut sutures into each incision. It is not necessary to remove all the external piles, as they usually shrink up after the operation upon the internal ones ; only prominent ones need be removed.

After the operation is finished, careful inspection is made to see that there is no bleeding, and a half-grain suppository of morphine is inserted into the rectum, a little iodoform is dusted over the parts, and a pad of salicylic wool is fastened between the buttocks with a T-bandage.

After-treatment.—The patient is put back to bed lying on his side with the pelvis raised upon a pillow and the bowels are confined for four or five days if necessary by the administration of a little opium. During this time the diet should be fluid and should consist largely of milk. On the fifth day a dose of castor oil should be given early in the morning and just before the action of the bowels occurs a large enema should be administered, followed by the injection of an ounce of warm olive oil within the sphincters. This first action of the bowels is often somewhat painful, but if a large enema be given there is usually little trouble. Should the patient feel faint, brandy or sal volatile may be administered. From this time onward the patient may be allowed to get up and may be put upon an ordinary light diet, while a laxative should be given every other day so as to keep the bowels open. The best for this purpose is confection of senna or liquorice powder, and immediately previous to the action an ounce of olive oil should be injected into the rectum which will minimise any smarting.

As a rule the disturbance following this operation is very slight indeed. In some cases, especially in men, there is retention of urine, but this is usually transient and causes no trouble. Micturition can often be performed by allowing the patient to get on the hands and knees, and there is no objection to this being done. The pain is trifling, if care be taken to dilate the sphincter fully at the time of the operation. Any there is is due to spasm of the sphincter, which is best treated by the application of a large sponge wrung out of boiling water and firmly applied against the anus.

Internally, opium or morphine may be administered. At the end of the first week the patient can generally sit upon a hard seat, and can often return to work within a fortnight. When there are external piles, and these are not removed, there may be a good deal of swelling around the anus for some days after the operation, but this subsides as soon as the bowels are opened, and the external piles shrink up.

Ligature.—This method was the one formerly chiefly in vogue, and it is still strongly advocated by some. The sphincter is fully dilated, the pile is pulled down by forceps, the mucous membrane around its base is snipped through with scissors and the pedicle tightly tied with a stout silk ligature; if large, the pedicle is transfixed. The parts are then returned within the anus. The object of snipping through the mucous membrane before applying the ligature is to diminish pain.

The chief reason urged in favour of this method is the avoidance of hæmorrhage, but we must confess that in our opinion it does not bear comparison with either of the plans we have already described. The presence of silk ligatures in a septic part like the rectum must necessarily be a source of irritation and danger, whilst the sloughing of the pile and the separation of the ligature are apt to be accompanied by septic thrombosis and a risk of secondary hæmorrhage. We must confess also that what we have seen of the pain and discomfort following this operation contrasts most unfavourably with the results of the clamp and cautery method.

Treatment of hæmorrhage occurring in connection with piles.—This may be divided into bleeding occurring as a complication of piles and bleeding occurring as an accident, either during or after one of the operations for their relief. In the two latter cases it is a most troublesome and unpleasant complication, which however should be excessively rarely, if ever, met with when the operation is properly performed. In our own practice we have never had to deal with a case either of immediate or secondary hæmorrhage following operation.

Hæmorrhage complicating piles.—This is a mere symptom; the removal of the hæmorrhoids will cure the bleeding. Should however the patient decline operation, or should the latter be considered inadvisable, it may be necessary to employ local measures directed to the arrest of hæmorrhage. For this purpose the ordinary palliative treatment already described (see p. 48) must be adopted and, in addition, the use of astringents locally will be advantageous. Amongst the best of these is the tincture of hamamelis diluted with an equal quantity of water, half an ounce to an ounce of this being injected through the sphincter and left in the bowel each time after an action has occurred. In ordinary cases injections of cold water or of simple lead lotion may be useful, whilst in bad cases suppositories containing one to three grains of sulphate of iron may be tried. It is of course most important to take adequate measures against constipation, which is a most prolific cause of bleeding.

Hæmorrhage during an operation for piles rarely causes trouble, provided that the surgeon has fully dilated the sphincter. The area from which the bleeding comes is then always under inspection, as the whole pile-bearing area can be protruded easily through the anus, and the bleeding point can either be picked up with forceps and tied or it can be touched with a pointed cautery and the bleeding effectually checked. If a cautery be employed in this manner, it will be necessary to protect the rest of the circumference of the bowel by introducing a large bivalve speculum.

Hæmorrhage immediately after an operation, when the patient has been put back to bed, may prove very serious unless it be recognised early, for it must be remembered that very free bleeding may take place into the bowel without any external sign, and the rectum may be enormously distended with clot without the appearance of any blood externally. Indeed the first symptom may be that the patient faints and shows all the signs of severe hæmorrhage, such as breathlessness, restlessness, etc. (see Part I., p. 135). It is of cardinal importance to see that all bleeding has ceased before the patient is sent back to bed.

When bleeding has occurred the treatment must be prompt. The patient should be anæsthetised, the sphincters fully dilated, and all the clots should be turned out of the rectum. The surgeon then seeks, with the aid of a good light, to identify and secure the bleeding spot. As a rule this is fairly easy, as little or no inflammatory swelling will have taken place; the parts may be readily protruded through the anus and the bleeding point actually seen, when it may be suitably treated by ligature, under-running, or the application of a cautery.

True secondary hæmorrhage, which comes on at any period from the fifth to the tenth day, when the sloughs or ligatures are separating, is however very difficult to treat effectively. Here the bleeding, although as a rule not so profuse as in the accidental form, may be so persistent as to place the patient's life in jeopardy within a short time, and it is therefore urgently necessary to arrest it. In the first place an attempt should be made to secure the bleeding vessel, which should be done by fully anæsthetising the patient, dilating the sphincter, everting the parts, and trying to see where the bleeding comes from. Here however there is great difficulty because of the swollen and inflamed condition of the parts and the fact that the bases of the piles are covered by granulation tissue, and it may be quite impossible to pick up, to tie, or to under-run the bleeding spot, or even to stop the bleeding by a cautery. Under these circumstances a pair of Spencer Wells' forceps may be made to seize the bleeding area, left on and allowed to come away subsequently by a process of ulceration, or, failing this, the method described by the late Professor Henry Smith may be tried. He introduced a large-sized bivalve speculum into the anus and dilated it to its fullest extent. The blades thus pressed firmly against the bleeding point and served to arrest the hæmorrhage. The speculum was left on for some hours, and then cautiously removed. The efficacy of this method may be

increased still further by covering the outer surface of the blades of the speculum with several thicknesses either of boracic lint or of cyanide gauze, which serves to increase the size of the speculum, and assists its compressing power. Another useful method, in very bad cases, is to employ the ordinary *tube en chemise* for plugging lithotomy wounds (see Fig. 16). This is passed well up through the anus, and sponges are thrust up in the interval between the tube and its surrounding petticoat so as to stretch the sphincter thoroughly, and to exert firm pressure against the bleeding spot. The tube is then tied in by fastening on an ordinary T-bandage, and, after the bleeding is stopped, it is withdrawn by gradually removing the sponges, generally at the end of twenty-four hours.

In these cases it will not infrequently be found that the patient has lost so much blood that either a large enema (2 pints) of normal saline solution, or still better, an intra-venous infusion of the same quantity, will be required.



FIG. 16.—TUBE EN CHEMISE. The gauze for exerting pressure is packed tightly in between the tube and its petticoat.

TREATMENT OF COMPLICATED CASES.

Operative.—Practically speaking any complicated case may be treated by one of the operative methods above described. There is no reason to delay operation because a pile is thrombosed or inflamed, and in our opinion it is best to employ the clamp and cautery in all these cases in preference to either of the other methods; the prolonged searing of the parts shuts off the vessels and there is less risk of absorption than there would be in a clean-cut wound.

Palliative.—Sometimes however the patient refuses to be operated upon, or visceral disease, advanced pregnancy, etc., may contra-indicate it and the following palliative measures may then be employed.

When the piles are prolapsed and irreducible it is of the greatest importance that they should be returned within the anus, as otherwise strangulation is very apt to occur. The protruding mass should be sprayed with a saturated solution of eucaine, after which the patient is placed in the genu-pectoral position, the prolapsed mass is gradually compressed so as to empty it as much as possible and is then thoroughly lubricated and pushed inwards with the fingers of one hand whilst the forefinger of the other is passed into the anus to guide it upwards. When the mass has been successfully returned, a pad of boracic lint is pressed firmly against the anus and kept in position by a T-bandage applied as tightly as it can be borne. The patient should then remain in

bed for 24 hours at least, lying upon one side with the buttocks slightly raised upon a pillow so as to prevent the mass coming down again. The bowels should also be confined for a day or two.

Should this manipulation fail to reduce the piles, the best plan is to apply hot boracic fomentations, which in this particular region is best done by wringing a soft sponge out of boracic lotion as hot as it can be borne, applying it to the anus, covering it over with a large mass of cotton wool and renewing it as frequently as it gets cold. This method will be most commonly used in cases of a large inflamed mass of mixed internal and external piles where reduction is out of the question, as any attempt to push these mixed piles up above the sphincter only gives rise to great pain and causes increased inflammation from the spasmodic contraction of the sphincter upon them. Unless this treatment rapidly relieves the swelling, operation should be urged, even in the face of considerable contra-indications, as the risk is much less than that of allowing the piles to become gangrenous, which is what will probably occur.

The treatment of gangrenous piles is identical with that of the inflamed irreducible variety just mentioned and consists in their immediate removal by the clamp and cautery or by the application of hot fomentations, etc., if operation be refused or be thought inadvisable. Considerable quantities of morphine will be required to allay the acute pain present in these cases. The treatment of isolated thrombosed piles, which generally are of the external variety, has already been dealt with (see p. 50).

CHAPTER IX.

PROLAPSE OF THE RECTUM.

By this term is meant a protrusion of portions of the mucous membrane or of the whole thickness of the gut through the anus. Some authors have divided the condition into two distinct groups, calling prolapse of the mucous membrane a prolapse of the anus whilst, when the entire wall of the gut is extruded, it is termed prolapse of the rectum. In the normal state of matters there is always a certain amount of protrusion of the mucous membrane during defæcation; in some of the lower animals, such as the horse, this is very marked. In prolapse the sphincters are always much dilated, the external one particularly, and no longer exert their proper influence.

CAUSES.—The most important cause is probably feebleness of the sphincter ani and this is usually accompanied by an unduly lax condition of the rectal walls, chiefly the submucous tissues; possibly also there is an unduly long meso-rectum. The result is that any straining protrudes the bowel, which is then protruded still further as a result of the tenesmus to which its presence gives rise.

The condition occurs at all ages but is most common in infancy and in old age. In young children it is generally caused by continued straining due to phimosis, constipation, the presence of worms or the existence of a stone in the bladder, and it is frequently met with in marasmic children, probably as the result of simple weakness. In old age it may also be caused by straining due to stone in the bladder, stricture of the urethra or enlargement of the prostate, but here general weakness of the parts concerned plays a very important part. It is also predisposed to by the constant coughing and straining that occurs in chronic bronchitis.

SYMPTOMS.—There is a frequent desire to empty the bowel, followed by the passage of mucus and the protrusion of a red, fleshy mass from the anus which usually returns spontaneously on the completion of the act of defæcation, but which when large may remain outside and require reduction. The prolapsed mass differs from piles in that it does not bleed readily unless

severely handled and in that it consists of a uniform protrusion marked transversely with the rectal folds and with the orifice of the bowel forming the apex of the swelling; there are no projecting masses such as are seen in the case of piles. Prolapse of the rectum must be diagnosed from an intussusception that has travelled down sufficiently far to protrude through the anus. It is distinguished by the fact that in true prolapse there is no sulcus around the protruded portion; the latter starts directly from the anal orifice, whereas in an intussusception the prolapsed portion comes down through the anal ring and a finger can be passed between the intussusception and the anal mucous membrane well up into the bowel.

If the condition remain untreated it causes much annoyance and gives rise to permanent loss of power of the sphincters from over-stretching. The protrusion itself becomes thickened, swollen and ulcerated, and may finally become irreducible; in some rare cases it has been known to become gangrenous.

TREATMENT.—The chief points are to remove the cause if possible, to see that the prolapsed portion is kept reduced, to prevent protrusion in the intervals between the actions of the bowels, to diminish straining at stool and to improve the local muscular tone. When the structures are so lax and the sphincters so feeble as to preclude any possibility of spontaneous recovery of power, it may be necessary either to excise the prolapse or to pull up the bowel and fasten it in such a position that it will not prolapse again.

(a) **In infancy.**—In the first place anything causing straining during defæcation or micturition must be remedied. Worms, polypi, hæmorrhoids or stone in the bladder should be removed; phimosis or constipation should be treated appropriately and general hygiene should be attended to. The local treatment consists in reducing the prolapse whenever it occurs and keeping it up in the intervals between defæcation. The prolapsed portion should be reduced by gently squeezing and pressing it backwards with the well-oiled hand after the parts have been washed with warm water and a soft sponge. When the prolapse has been reduced, it is well to give a cold douche to the anus and perineum. Recurrence of the protrusion may often be prevented by fastening the buttocks firmly together with a broad piece of strapping passing from the great trochanter on one side to that on the other. Children who are subject to prolapse should be made to evacuate the bowels lying either upon the back or upon one side, as by these means straining is diminished; it has been recommended that they should be encouraged to do so while in a warm bath. If the child be wasted, every effort should be directed to improve the general health; in many cases simple tonic, hygienic and dietetic treatment will cure the condition without any trouble.

(b) **In young adults.**—Here the condition is rare, and is usually the result of stricture of the urethra, piles, or polypi, which can be easily treated, when the protrusion will spontaneously disappear, the cure being facilitated by the administration of tonics, such as strychnine, and the local

application of the faradic current, one pole being placed over the lower part of the lumbar spine, whilst the other is introduced into the anus.

(c) **In old age.**—In elderly subjects the treatment is very difficult. Not only may there be local causes present which are very difficult to treat, but there is generally a feeble condition of the patient and a loss of tone in the muscles which are not promising for the regaining of power. In addition there is often some constantly recurring affection, such as chronic bronchitis, which tends to reproduce the condition. Here the milder methods above described are ineffectual, and some form of operation must practically always be employed. The following are the methods that have given the best results in our hands:

Linear cauterisation of the prolapse.—This method is only of use in the very slight cases where the mucous membrane alone protrudes, and should not be used if there be reason to think that the entire bowel-wall is prolapsed. The patient is placed under an anæsthetic in the lithotomy position, and the parts are well protruded. Either fuming nitric acid or the actual cautery may be used. If *nitric acid* be employed, the surface of the prolapse is dried and a series of longitudinal lines are drawn on the mucous membrane from the margin of the anus to the apex of the protrusion. The acid is allowed to act for ten minutes and is then neutralised by douching with a solution of carbonate of soda. The protrusion is smeared with vaseline, and strips of muslin covered with ung. eucalypti are laid over the cauterised area; the protrusion is returned within the anus and kept up by a large pad of boracic lint and salicylic wool, fastened on by a T-bandage. Before the protrusion is returned, a suppository is introduced into the rectum; after four days' confinement the bowels are moved every other day by a suitable laxative.

The *actual cautery* is more effectual than nitric acid; it is applied very similarly, and care should be taken to have it only at a red heat. The object of the cauterisation is to provide a series of vertical cicatrices around the bowel, which will contract on healing, and shorten the structures in the vertical direction, so as to pull up the prolapse. Both methods give a rather painful and protracted convalescence.

Excision of portions of the prolapse.—When the protrusion is very marked, portions of the mucous membrane of the prolapse and the skin around the anus may be removed by excision, so as not only to mechanically diminish the size of the protruded mass, but also to lessen the calibre of the anus, and so to form a barrier to the escape of the bowel. This is done by excising four to six diamond-shaped portions around the anus (see Fig. 17), one part of each diamond consisting of mucous membrane and the other of the skin around the anus. The long axes of the portions removed are parallel to the long axis of the bowel. Generally speaking, a much larger amount of mucous membrane than of skin is removed, but this will vary according to the laxity of the sphincter. The portions to be removed are marked out with a knife, and are then

dissected up from the submucous and subcutaneous tissues respectively, and the sides of the incisions thus formed are sutured accurately so as to convert them into longitudinal cicatrices, which will serve to pull up the part by their contraction. Catgut sutures should be employed for the mucous membrane, whilst horsehair serves for the approximation of the skin. A suppository is inserted, the prolapse reduced, and a pad of boracic lint is applied outside the anus. The bowels are kept confined until the fourth day, when they should be opened every other day with



FIG. 17.—METHOD OF EXCISING PORTIONS OF A PROLAPUS ANI. This shows, somewhat diagrammatically, how the elliptical or diamond-shaped pieces are placed. The major portion consists of mucous membrane, the skin around the anus only furnishing a small part. The small diagram in the right-hand lower corner is intended to represent the appearance of the prolapse looked at from above after removal of the portions of skin and mucous membrane. It shows how suture of these incisions not only provides longitudinal cicatrices but largely diminishes the bulk of the prolapse.

a laxative. The after-treatment is the same as for the simpler cases, and it is important to try the effect of tonics, such as strychnine and the application of the faradic current (see p. 63). Only the horsehair sutures will require to be removed, the catgut ones will become absorbed.

Excision of the entire prolapse.—The method just described is only suitable for cases in which the mucous membrane and not the entire wall of the bowel prolapses. It only removes portions of the mucous membrane, and in cases of complete prolapse the muscular wall of the bowel would still tend to come down, being only stopped by the artificial contraction produced about the anal orifice. In cases therefore of complete prolapse of the bowel some more efficacious method is necessary, and the same may be said of

a very large prolapse where the mucous and submucous coats are alone concerned. The most trustworthy method is entire removal of the prolapsed portion, and the exact steps of the operation will vary according as the mucous membrane only or the entire bowel wall is involved in the prolapse.

When the mucous membrane alone forms the prolapse, the operation of excision is practically identical with Whitehead's operation for piles (see p. 51). An incision into the submucous tissues is made to follow accurately the muco-cutaneous anal margin, and the sleeve of mucous membrane is dissected up with scissors and fingers until the upper limit of the prolapse is reached. During the process of separation the everted mucous membrane becomes inverted once more. A circular division of the mucous membrane is made at the upper limit of the prolapse as in Whitehead's operation and the cut edge is united to the anal margin in an exactly similar manner. The *after-treatment* is also the same (see p. 53). The operation should be done with the prolapse down to its full extent, and when the section of the mucous membrane is made no traction at all should be exerted, so that the cut edge of the mucous membrane may lie easily in apposition with the skin around the anus and so there will be no tension on the stitches and no risk of a stricture.

When the whole thickness of the bowel wall is in the prolapse, the operation is done as follows: The patient is put into the lithotomy position, the prolapse is protruded to its utmost limit and thoroughly cleansed with a 1 in 2000 sublimate solution, and then an incision is carried into the submucous tissue all around the anus at the junction of the skin with the mucous membrane. The incision is steadily deepened through the entire thickness of the prolapse, bleeding points being clamped as they are met with, and the mucous membrane being stripped somewhat downwards as before until the peritoneal cavity is opened. The opening must be small in the first instance lest small intestine should prolapse. Elevation of the buttocks will prevent this, the intestines falling away as air enters the peritoneal cavity. There is little risk of soiling the peritoneum as the gut becomes inverted again when the prolapse is divided all round, so that the mucous membrane is no longer outside. When the peritoneal cavity has been opened all round, the bowel is gently drawn down as far as it will come, and the cut edge of the parietal peritoneum is sutured to the peritoneal coat of the bowel, and the protruding portion of the latter is then cut off, the cut edges being sutured to the skin around the anal margin. The best way to do this is to divide it by a series of short snips following each division by suture of the divided bowel wall to the corresponding surface of the skin about the anus, and if necessary clamping and tying any bleeding vessels. As a rule there is very little bleeding except posteriorly where the large vessels run in the meso-rectum. The suturing must be very accurate and there must be no tension upon the stitches, while at the same time care must be taken to

draw the bowel down as far as it will readily come as otherwise the prolapse might subsequently recur. The sutures should be either of stout catgut or silkworm gut. In the latter case their ends should be left long so that they may be identified and removed subsequently. We have treated several cases in this way with great success and complete control over the bowel has been regained. At the same time the operation is comparatively severe and should only be employed for bad cases in which a considerable amount of the entire wall of the bowel is protruded.

Colopexy.—Two other methods that have been employed for the treatment of prolapse require mention, namely, attempts to shorten the prolapsed portion by suturing the bowel either to the abdominal wall or to the neighbourhood of the coccyx; of these ventral fixation is the one more often practised at the present time. It has however the disadvantage that, although the immediate result is very satisfactory, the union is apt to stretch and the prolapse to recur. Further than this, it does not affect the portion of the prolapse that is caused by the sliding of the mucous membrane over the submucous tissue, so that, in order to make the operation complete, it must be reinforced by removal of whatever portion of the mucous membrane remains prolapsed.

The operation itself is simple enough and consists in opening the abdominal cavity just above the left inguinal canal, seizing the lower part of the sigmoid flexure and pulling it up from the pelvis so as to exert traction upon the rectum which is pulled as far upwards as it will go. Then the sigmoid flexure is fixed in position by stitches passing from the meso-sigmoid to the peritoneum in its immediate neighbourhood. These sutures may be reinforced if necessary by others attached to the appendices epiploicæ; indeed the fixation may be carried out by any method that the surgeon may deem best at the time. The abdomen is then closed in the usual manner and the after-treatment is as for an ordinary laparotomy. Any protrusion of mucous membrane that occurs subsequently must be dealt with separately, the best plan being to perform simple excision of it, as in Whitehead's operation for piles (see p. 51).

Rectopexy.—Another method is to stitch the bowel up to the neighbourhood of the coccyx, which is done through an incision in the middle line reaching from just behind the anus to the tip of the coccyx. This is deepened until the lower end of the bowel is exposed and the latter is cleared of its fat and pulled upwards by the fingers in the direction of the coccyx, when the prolapse, if moderate in amount, will disappear. Two or three catgut sutures are made to transfix the muscular wall of the bowel and are then inserted into the tissues in front of or at one side of the sacrum or coccyx. When traction is exerted upon these the bowel is pulled up and the prolapse disappears. If there be considerable prolapse the stitches must be inserted as high up alongside the sacrum as possible. The operation might be rendered more efficacious by excising the coccyx, prolonging the vertical incision upwards over it, and then inserting the sutures from the

bowel to the periosteum below the sacrum. The perineal wound is brought together with a few silkworm-gut stitches and a small antiseptic dressing is fastened on with collodion; the bowels are kept confined for a few days and primary union generally results.

While the immediate results in this operation are usually very satisfactory, they do not last very long and the prolapse generally recurs in a few months. It may be advantageously combined with a linear cauterisation after the perineal wound has healed, or any prolapsed mucous membrane remaining may be removed, as in Whitehead's operation (see p. 51). Neither of these procedures, however, compares either in accuracy or in its results with complete excision of the prolapse, which is the method of choice where the milder measures such as cauterisation fail.

CHAPTER X.

NEW GROWTHS OF THE RECTUM.

POLYPUS OF THE RECTUM.

THIS is the usual form of innocent growth of the rectum. It is generally met with in the lower two inches of the bowel although occasionally it occurs higher up. It is most common in children, and generally springs from the dorsal aspect of the bowel. The great majority of polypi of the rectum are adenomata and they are generally pedunculated owing to their weight and the traction exerted during defæcation. Myomata, fibromata or lipomata also occur, but are very rare; a warty villous tumour of the rectum has been met with, although this is very rare, as are also cysts.

SYMPTOMS.—The symptoms are usually unmistakable whenever the pedicle of the tumour is of any considerable length. When however the polypus is situated high up in the rectum there may not be any diagnostic symptoms. When in the usual situation, low down in the bowel, there is tenesmus accompanied by the passage of mucus and sometimes blood, and, when the pedicle is sufficiently long, the tumour may protrude through the anus, bleeding at the least touch and being bright red and fleshy in appearance. The tumour generally recedes spontaneously after defæcation; sometimes however the pedicle may be so long that the growth remains outside and becomes markedly congested. When the polypus is situated high up in the bowel there may be a true intussusception of the rectum, the polypus forming its apex.

With a little care the diagnosis is easy, as the finger introduced into the rectum will distinguish the fact that the tumour possesses a pedicle which is attached to the wall of the rectum above the pile-bearing area, and there should therefore be no difficulty in diagnosing it from hæmorrhoids.

TREATMENT.—The patient should be fully anæsthetised, the anus should be dilated, the parts thoroughly examined and the tumour seized and pulled down with a pair of pile forceps. Careful examination must be made in doing this to see whether the tumour is single or multiple as

more than one is not infrequently met with at the same time, and the removal of one may therefore not suffice to cure the symptoms. The pedicle must then be ligatured, and it is very important, especially when the polypus is large, to avoid any possibility of the ligature slipping, as that would result in severe hæmorrhage high up in the bowel and only reached with difficulty. We are therefore accustomed to transfix the pedicle with stout catgut and tie it in two halves. Transfixion in the rectum is of course open to the objection that septic material may become absorbed from the ligature as it traverses the soft parts and we generally therefore apply a second ligature behind or on the proximal side of the first, surrounding the entire pedicle and so preventing any possibility of absorption. During the tightening of these ligatures all traction upon the pedicle must be relaxed so as to ensure complete strangulation. The polypus is then snipped off, the ligature is cut short and the patient kept in bed or on a couch for a few days whilst the bowels are kept confined for that period. After the bowels have acted the first time, the patient may be allowed to get up and a laxative may be administered every other day. If removal be practised in this way there is really no risk of hæmorrhage.

CANCER OF THE RECTUM.

This is quite a common affection. It occurs more often in men than in women, usually after middle life, but it may be met with at an early age, in which case the growth is extremely malignant. The typical growth is a columnar epithelioma, but a squamous carcinoma may spread upwards from the anus into the bowel. True scirrhus of the rectum, formerly looked upon as common, is practically unknown; sarcoma is extremely rare.

A cancer of the rectum begins in the mucous membrane, usually on the posterior aspect of the lower end of the bowel, and may form a slow-growing mass gradually encircling the bowel and leading to marked constriction or, much more frequently, an extensive warty tumour undergoing ulceration, and involving a considerable area of the bowel. A long time often elapses before the bowel is completely encircled by this form of growth, and any obstructive symptoms are due to the mass fungating into its lumen rather than to narrowing of the calibre of the intestine.

The disease infiltrates the muscular coat as it spreads, and ultimately reaches the peri-rectal tissues. Should it involve the peritoneum, it may cause a cancerous peritonitis, or it may involve structures such as the ovary, bladder, or other parts of the intestine, and give rise to a variety of troubles in consequence. When it spreads into the peri-rectal cellular tissue it fixes the intestine to the hollow of the sacrum, and constricts the nerves in this neighbourhood giving rising to severe pain.

The glands become affected with a rapidity depending on the variety of the cancer. The glands affected are those in the hollow of the sacrum in immediate contact with the posterior rectal wall, and thence the infection

spreads to the lumbar glands; the inguinal chain is only affected in cancer involving the anus. Secondary deposits eventually occur in the liver, and this is one of the common causes of death in this affection. Secondary growths usually increase more slowly than the primary one, especially when the latter is of the fungating variety.

SYMPTOMS.—The symptoms depend largely on the nature and progress of the disease. In the constricting form the earliest symptoms are those of obstruction. The more common fungating form, however, will usually be diagnosed long before obstruction sets in. In the latter cases the earliest symptom is rectal uneasiness, accompanied by diarrhœa, most marked in the morning; when the patient goes to stool only a little mucus mixed with blood and débris passes, leaving a sensation that the bowels have been insufficiently relieved, so that a second attempt is necessary. The trouble is, however, often so slight that the patient takes little notice of it, thinking that he is merely suffering from some chronic diarrhœa. In other cases again there is alternate diarrhœa and constipation, and generally there are marked dyspeptic symptoms. One of the earliest characteristic symptoms is that the patient, although quite comfortable in bed, finds a mucous or foul discharge escaping from the anus directly he gets up in the morning. After emptying the rectum he remains fairly comfortable for a considerable time, but often has to seek relief more than once during the day on account of this spurious diarrhœa.

When the growth is situated low down, the sphincters become relaxed, and there is often a want of complete control over the motions accompanied by a continuous mucous discharge from the anus which is sometimes acrid and may lead to excoriation of the skin; this discharge is often blood-stained, but profuse bleeding is rare.

Severe pain is a late symptom, and there is little or none so long as the growth is confined to the substance of the bowel, all that is complained of being a colicky condition and tenesmus, and the general discomfort associated with obstruction. When, however, the disease extends beyond the wall of the bowel, the nerves in the hollow of the sacrum become involved, and the patient suffers from a constant dull aching in the buttocks and thighs, which becomes excruciating as the nerves become more severely compressed.

Digital examination of the rectum shows either a fungating mass confined to one segment of the bowel with healthy mucous membrane elsewhere, or else it reveals an annular narrowing of the gut, presenting a more or less central ragged opening closely resembling a split cervix uteri. The edges are densely indurated, and the opening itself is firm, and in many cases the finger cannot be passed through it. When the stricture is high up, the condition known as "ballooning" of the rectum may be present, accompanied by a more or less patulous condition of the anus. True piles may also occur, and should not be confounded with malignant masses protruding from the anus. It is also not uncommon for ischio-rectal abscess to form and to give rise to fistulæ communicating with the bowel about the upper limit of the growth.

In examining the rectum various points have to be made out with reference to the question of treatment. In the first place, the position of the disease has to be ascertained. In the second, the length of the stricture and its calibre; whilst, in the third place, the mobility of the parts, as indicating extension or otherwise through the rectal wall and adhesion to neighbouring structures, must be noted. Growths comparatively low down soon become adherent to the base of the bladder, the prostate or the vesiculæ seminales in the male, while in the female adhesion to the posterior wall of the vagina also occurs quite early. Another important point is the relation of the growth to the anal margin; cancer in this situation usually recurs much more rapidly than when it is situated entirely within the rectum.

TREATMENT.—There are three courses open to the surgeon. In the first place the disease may be left alone; the patient may decline operation or the surgeon may either think that operative interference is out of the question or the time for it has not arrived. In the second place, there is the question as to whether a true radical operation, such as excision of the affected portion of the bowel, is feasible. Finally, the surgeon may content himself with a colotomy, considering radical treatment to be out of the question and desiring to prevent impending obstruction or to remove obstruction already existing. The decision as to which of these lines of treatment he will adopt is the first and most urgent point to which the surgeon must direct his attention and it is most important in the first place to decide whether a radical operation is possible or not. Arising out of this question also comes an equally important one, namely, whether the radical operation is advisable as well as feasible.

Cases suited for excision.—The important points for consideration in deciding upon the feasibility of a radical operation are chiefly the situation of the growth and its mobility. *The situation of the growth* is most important from the point of view of its accessibility by one of the routes employed for excision. A growth near the anus is readily accessible, whilst one situated at the very commencement of the rectum is much more difficult to get at, and it was the rule until recently that growths that were reached with difficulty by the finger in the rectum were to be looked upon as beyond the range of an excision. It must not be considered however that the mere position of the growth renders its removal impossible. A growth situated at the very commencement of the rectum may be excised readily enough through a laparotomy wound, provided that there be no other contra-indication to its removal, although it may be quite impossible to reach it satisfactorily either by the perineal or the sacral route. The really difficult cases are those in which the growth is situated near the middle of the rectum, as, if the tumour be at all extensive, the sacral route may prove unsatisfactory. Even here however, if other conditions be favourable, the growth can usually be removed by a combined abdominal and perineal operation. Therefore the situation of the disease is of more importance in deciding the method of operating than in determining whether radical measures should be undertaken.

The relation of the growth to the neighbouring parts and its consequent mobility are far more important. As long as the portion of bowel involved is freely movable it implies that the disease is confined to the rectal wall and has not infiltrated the surrounding tissues. The only exception to this statement is that possibly the peritoneal surface may be involved while the growth remains freely movable. If the bowel be mobile we may fairly assume that the disease has not reached the peri-rectal cellular tissue and that therefore it is suitable for removal. On the other hand, if the bowel be immobile it implies that the growth has passed beyond the bowel wall and is infiltrating surrounding structures and that the chances of excision are small. If it be adherent in the hollow of the sacrum, and particularly if there be symptoms referable to involvement of the sacral nerves, the chances of obtaining a radical cure are remote indeed, for not only will it be extremely difficult to dissect out the tumour from the peri-rectal tissues, but the disease will almost certainly have involved the glands so high up that their effectual removal is out of the question. When the growth has only passed beyond the limits of the rectum anteriorly and has begun to involve the prostate, it is no doubt possible to remove it along with a portion of that organ; but it must be admitted that, as soon as the growth has lost its free mobility in any direction, the chances of a radical cure are very slight, and an attempt at obtaining one is only justifiable in the presence of very strong reasons for it, such as a tumour of extremely slow growth in a vigorous patient who urgently desires a chance of life and declines palliative treatment. In our opinion want of mobility of the tumour strongly contra-indicates radical operation.

Symptoms pointing to the involvement of other organs, more particularly the liver, are also against radical operation. This is however not by any means the universal opinion as some strenuous advocates of excision advise it in preference to a colotomy even when the liver is known to be affected, and assert that the secondary lesions grow much more slowly than that in the rectum and that therefore the patient may have his life considerably prolonged if the local spread of the disease be cut short by excision; they further urge that the functional result is better after an excision than after inguinal colotomy alone. Although we do not think the latter point can be strongly upheld, there is no doubt that a growing cancer in the pelvis is a source of increasing trouble to the patient and may cause a vast deal of misery before secondary deposits in the liver or elsewhere cause death, and therefore there may be some justification for the foregoing view. In our opinion however it is well to regard secondary deposits in the liver or in any inaccessible organ as a strong contra-indication to radical operation, except under very exceptional circumstances.

A third question, namely, the *presence or absence of obstructive symptoms*, has also to be taken into consideration. A patient suffering from intestinal obstruction is clearly not in a suitable condition for a radical operation, although other circumstances might render it advisable. The obstruction

must be relieved before extirpation can be undertaken. The same remark applies to cases where the obstruction is only partial and the bowel above the stricture is much distended. The treatment of this complication may or may not involve a preliminary colotomy.

The final point requiring consideration is the *general condition of the patient*. Many sufferers from cancer of the rectum are in a state of semi-starvation. They fear to take food because it aggravates the obstruction and they are wasting from the severe dyspepsia associated with the disease. Many of them therefore, although the local conditions are favourable, are unfitted for a radical operation for this reason ; this applies especially to old subjects whose recuperative power is very slight and who may therefore sink after the operation from mere weakness.

The cases suitable for excision may therefore be summed up as those in which the disease is well within reach of the finger, where the mass is freely movable and where the patient's condition is good. Excision must also be considered for cases of growth high up in the rectum, provided the bowel be movable, but here a definite decision can hardly be arrived at unless an exploratory laparotomy be first undertaken.

The cases unsuitable for excision are mainly those of extensive growth with fixation and marked glandular infection ; the operation should not be advised when the patient is much debilitated or very old and wasted, nor should it be done when actual obstruction exists. Cancer of the rectum in subjects under 35 is of a particularly malignant character and early recurrence is the rule ; these cases therefore should be looked upon as unsuited for excision unless seen in the very earliest stage. A somewhat similar remark applies to disease about the anal margin ; this is of very malignant type and unless seen quite early is not suited for excision as rapid recurrence is likely to follow. We have already expressed our opinion that extension of the disease to the prostate negatives excision and we are still more strongly of opinion that, if the base of the bladder be implicated, the operation is out of the question.

There are cases which, although unsuitable for excision when first seen, may become suitable under proper treatment. These are the cases in which some obstruction is present but in which the local conditions are otherwise favourable for excision. If the symptoms of obstruction be acute, it will be necessary in the first instance to perform a colotomy to relieve the obstruction and then, after the patient has recovered from the attack of obstruction, it may be quite possible to deal with the growth by excision. Similarly, in cases where the obstruction, although not acute, is marked the general health will often improve so much after colotomy that excision may be safely done after a few weeks' rest.

Finally, there are cases in which it is impossible to say whether excision or colotomy should be done. These are essentially those in which the upper part of the rectum is the seat of the growth and where the conditions cannot be accurately gauged without a preliminary laparotomy. The right

treatment here will be to perform a supra-pubic median laparotomy and to examine the condition of affairs. If the case be suitable for excision this may be proceeded with at once, or, if preferred, a preliminary colotomy may be done and an excision carried out subsequently or, should the growth be found unsuited for excision, a permanent colotomy opening may be established.

A very important point that the surgeon has to keep before him in all cases is that the severity of an excision of the rectum makes it necessary to see that the patient has a good chance of freedom from recurrence before the operation can be justifiably urged upon him. If an operation be rashly undertaken and it be found impossible to get satisfactorily wide of the growth, the patient at the end of a long convalescence is faced with a recurrence which will either necessitate his dragging his life out in misery or will call for a palliative colotomy.

Cases suited for colotomy.—Should the surgeon, after a consideration of the preceding points, decide against the excision, the next question is whether colotomy should be done forthwith. By some the principal point for discussion in the treatment of cancer of the rectum has been thought to be the advisability of excision versus colotomy. This, however, is not at all the position that we would take up. In our view they are two completely different questions. The first and most important point to be decided is whether an excision can be done. Should excision be decided against, the question then becomes whether or not an immediate colotomy is advisable. There should be no question of colotomy versus excision when the latter is feasible. Some surgeons urge that directly an inoperable cancer of the rectum is diagnosed colotomy should be performed forthwith. The chief arguments in favour of this view are that colotomy is a safe operation, that it relieves the patient of much discomfort, removes causes of irritation from the growth, and thus renders its extension more gradual, and therefore considerably prolongs life.

There is of course no question as to the safety of the operation, if it be done when there is no obstruction present; but the question as to the relief of pain is open to discussion. When patients suffer from constant deep-seated pain in the pelvic region this is probably due to involvement of the peri-rectal tissues and the nerves in the hollow of the sacrum, and colotomy will in no way relieve it; from this point of view, therefore, there is no advantage whatever in doing it. On the other hand, there is no doubt that when the chief troubles are pain on defæcation, with marked tenesmus or loss of power over the sphincter, accompanied by constant discharge from the rectum, the operation will ameliorate the condition and should certainly be advised.

Another condition calling for colotomy is obstruction, either actual or impending. This subject has already been dealt with (see Part VI., Sec. I., Chap. XIX.). After a properly performed colotomy the health improves rapidly as a result of the unhindered evacuation of the bowels,

but it may be well to remember that occasionally the finger in the rectum is able to ascertain that the actual or impending obstruction is caused by a fungating mass of growth, and not by an annular constriction, and that, under these circumstances, nearly the whole of the obstructing mass may be scraped away with a sharp spoon or snared off so as to relieve the obstruction completely, and the patient then is better off than after colotomy, as he retains full sphincteric action. In suitable cases—viz., those in which the disease is growing rapidly and in which the patient still retains sphincteric power, but has an objection to colotomy—this procedure is a proper and satisfactory one.

We are strongly of opinion that there is no real evidence to show that any atrophy or even diminution in the rate of the growth of a cancer of the rectum occurs after colotomy. No doubt a normal rectum will undergo atrophy after a properly performed inguinal colotomy; but that a growth will diminish under similar circumstances is pure theory without any evidence at all to sustain it, and in our opinion it is certainly not a sufficient reason to urge for the performance of the operation. We should say that, as long as a patient suffering from inoperable cancer of the rectum remains comfortable without colotomy, it is very much better that he should continue as he is, but that of course he should be kept under observation, so that, if at any time it should be found that his colon is not being properly emptied or that obstruction is impending, colotomy may be done without further delay. The patient's comfort is materially interfered with after colotomy by the presence of the artificial anus, and sensitive persons may be intensely upset by it, and therefore, if this condition be brought about by operation without any tangible benefit to show in exchange for it, the operation is likely to become discredited. We feel very strongly that, although colotomy is of the greatest value in cancer of the rectum, it should not be resorted to unless there be some definite indication for its performance.

Palliative treatment.—Should the patient refuse an operation, or should excision be deemed inadvisable and the time inopportune for a colotomy, palliative measures must be adopted to render the patient as comfortable as possible. The first point is to see that the bowels do not become loaded, and with this object the diet must be regulated, hard, indigestible substances being forbidden and the quantity and quality of the food being so arranged that it shall reach the large intestine as completely digested as possible. There is no more fruitful cause of obstruction in cancer of the rectum than the lodgment of hard, indigestible masses, such as fruit skins, undigested vegetable material, portions of bone, etc., above the growth. Suitable laxatives must be employed to avoid the possibility of the fæces remaining long enough in the colon to become indurated, and a good plan is to give the patient a grain or two of extract of cascara every night in a pill, and to follow this up with a dose of an aperient mineral water in the morning, so as to obtain a fluid evacuation

daily. This will often relieve the distressing tenesmus, which is so common in these cases. Should there be much pain, due to involvement of the peri-rectal tissues, opium must be given either by the mouth or as a sub-cutaneous injection rather than by the bowel, as it is doubtful whether the rectal mucous membrane retains its normal absorbing power under these conditions. When there is much offensive discharge from the growth, gentle irrigation of the bowel with warm solutions of weak sanitas, permanganate of potash, or boro-glyceride, will give great comfort. When there is much oozing from the growth, a rectal injection of half an ounce of tincture of hamamelis with an equal quantity of water, may be tried.

The general hygiene must be attended to and the patient should be encouraged to interest himself in his ordinary pursuits and to take plenty of fresh air and as much exercise as he can without exhausting himself. An active patient treated in this way will be much happier than if colotomy be performed at a comparatively early stage of the disease and will be much more ready to submit to the operation when its performance is essential. The average duration of life after colotomy performed fairly early in the disease is from a year to eighteen months, but occasionally cases occur in which many years elapse before death takes place. We ourselves have had cases living as long as six or seven years after the operation, but it must always be remembered that the latter part of these patients' lives is very distressing as they are bedridden and suffer much from involvement of other pelvic organs.

Operative treatment. Excision.—Excision of the rectum may be performed in any of the following ways:

1. By the sacral route which, with its various modifications, is the one most generally employed.
2. By the perineal route—the older method.
3. By the vaginal route.
4. By the abdominal route.
5. By the combined abdominal and perineal or sacral routes.

Preliminary measures.—Certain preliminary treatment must always be undertaken in order to minimise the risks of the operation, particularly septic infection of the pelvic cellular tissue. Many surgeons think that this danger is best avoided by a preliminary colotomy, but for our own part we have found this not only unnecessary but open to grave objections. In the first place it necessitates two fairly severe operations necessarily performed within a short period of each other; secondly, it often interferes with the proper manipulation of the bowel during excision, as the rectal segment is shortened by the fixation of the sigmoid flexure in the colotomy opening; lastly, its influence in producing asepsis of the excision wound is only partial as, although faecal matter does not pass over it, mucous and intestinal discharges containing plenty of organisms certainly do. For these reasons we are unable to advocate it. No doubt diversion

of the faeces may be of help when a portion of the rectum has been excised and the divided ends are reunited, but the colotomy opening has to be closed in order to complete the operation, and therefore a third formidable operation has to be added to the other two before the case is complete.

Before proceeding to excision, every effort should be made to empty the colon and this is best done by the repeated administration of laxatives, particularly salines, and frequent enemata. The diet must also be regulated and it is well to wash out the rectum twice daily for two or three days before the operation so as to remove as much as possible of the putrid discharge from the tumour. For this purpose sanitas or a solution of peroxide of hydrogen (10 vols. per cent.) may be employed. It is a mistake however to imagine that anything like true disinfection of the rectum before operation can be obtained. The question of the preliminary injection of anti-streptococcic serum has already been fully considered (see Part I., p. 183). Although other organisms come into play in the causation of the diffuse septic cellulitis after these operations, the streptococcus pyogenes is an active factor and the serum may be of value.

Immediately before the operation, a sponge or a cotton-wool swab should be introduced through the anus right up to the lower end of the tumour, partly to prevent the escape of foul discharge and partly to distend the rectum slightly and to render it more easily defined during operation; the anus should be closed by a few sutures.

While shock is not a very marked feature of these operations, except in the intra-abdominal forms, it is important to employ all the ordinary safeguards against it; these are fully described elsewhere (see Part I., p. 138).

The subsequent steps of the operation vary according to the route adopted.

1. Excision by the sacral route.—Excision of the rectum after removal of the coccyx was introduced some years ago by Kocher, and this was somewhat modified by Kraske who removed not only the coccyx but also a portion of the sacrum. Since then numerous modifications have been made consisting on the one hand in the removal of a larger portion of the sacrum, on the other in an osteo-plastic operation in which the lower end of the sacrum is turned aside and subsequently replaced. In all of them the removal of the sacrum stops below the third sacral foramen in order not to injure important nerves especially those supplying the bladder.

Kraske removes the left side of the sacrum by a curved incision running from the third left posterior sacral foramen to the mid-point of the lower margin of the sacrum. Hochenegg makes an oblique incision across the sacrum instead of a curved one. Bardenheuer cuts transversely across the lower end of the sacrum below the third sacral foramen. Rydygier performs an osteo-plastic resection of the sacrum dividing the attachments on the left side of the bone, and saws it across transversely just below the third sacral foramen turning the detached portion across to the right and then replacing it

in position afterwards (see Fig. 18); other surgeons have also modified his procedure in various ways. We may say concerning these osteo-plastic

operations that we are not inclined to recommend them as, although theoretically very tempting, in practice the replaced fragment of bone is apt to necrose.

There is no doubt that removal of a portion of the sacrum in addition to excision of the coccyx gives a good exposure of the lower end of the rectum and we are inclined to think that there is no advantage in confining the removal of the bone to the left side, as Kraske recommends. We are in the habit of dividing it transversely below the third sacral foramen as this gives much more room (see Fig. 19).

As it is not always possible to be sure beforehand how much bone will require removal, it is well to begin by merely excising the coccyx; after exposing the rectum it will be seen how much more bone should be taken away. The steps of the operation are as follows:

The patient is turned over almost on to the face with the left side of the pelvis elevated upon a pillow. A very good plan is to place a large sandbag over one end of the table and then to turn the patient over on his face so that the pelvis rests upon the sandbag, at the same time raising the left side by a smaller sandbag under the left anterior superior spine. The knees hang over the table and rest upon a chair whilst the foot of the

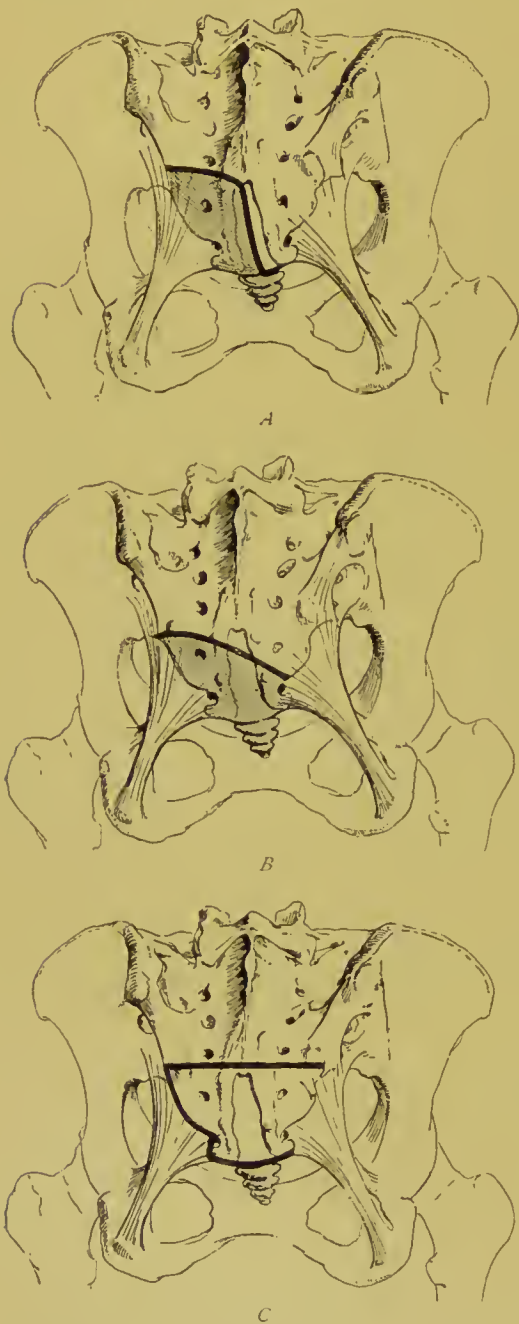


FIG. 18.—VARIOUS METHODS OF DEALING WITH THE SACRUM IN EXCISION OF THE RECTUM. *A* is the line of bone section in Kraske's original operation, *B* is Hochenegg's, while *C* shows the lines of separation of the sacrum in Rydygier's osteo-plastic resection. In all cases the coccyx is removed. The skin incision is usually a median one.

table is raised so as to carry the intestines away from the pelvis. Another method of doing the same thing is to suspend the pelvis over a strap

passed beneath it so that the patient is almost in the genu-pectoral position.

The parts having been shaved and disinfected, a median incision is made from just behind the anus to the lower border of the sacrum. If it be necessary to extend the skin incision it should be diverted slightly to the left side. The soft parts are raised down to the coccyx off which the periosteum is peeled and the structures attached to it are then divided close to the bone and the tissues separated from its anterior surface with a raspatory; the bone is then easily disarticulated and removed. This is often followed by smart bleeding from the middle sacral artery which, however, is easily picked up and twisted. The fat and fascia covering the levator ani are then exposed and are divided in the middle line through-

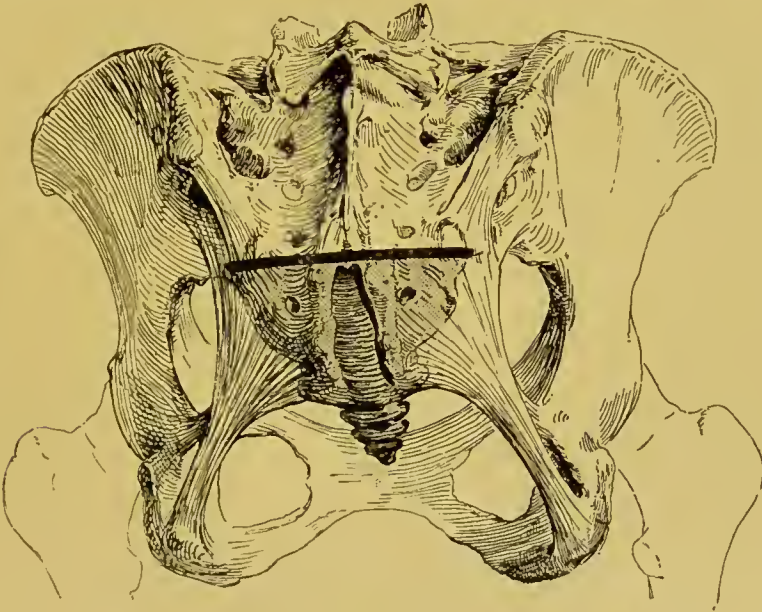


FIG. 19.—BARDENHEUER'S LINE OF DIVISION OF THE SACRUM IN EXCISION OF THE RECTUM. This is the line of bone section recommended in the text. The coccyx is also removed.

out the whole length of the wound which is deepened between the levatores ani until the cellular tissue immediately outside the rectum is reached. With a very little manipulation the tumour in the rectum can now be felt and its limits ascertained and it will then be evident whether more bone must be taken away. If necessary, the posterior surface of the sacrum is cleared up to the third sacral foramen, the muscles and ligaments separated on either side and the periosteum cleared from the front of the bone. With a chisel or powerful punch forceps as much of the bone as is necessary may be removed as far up as a line drawn transversely just below the third sacral foramina.

After the bone has been removed, all bleeding points are secured and the median incision in the deeper parts is extended upwards as far as possible; this exposes the rectum with the peri-rectal tissues and glands and the levator ani below. When it is evident how much of the rectum

will require to be removed the surgeon has next to make up his mind as to what shall be done with the divided end of the bowel after the growth has been cut away.

There are four possible ways of dealing with the divided end of the bowel after excision of cancer of the rectum. The ideal method is to join the divided ends together and thus to restore the continuity of the bowel. A second plan is to bring the lower end of the rectum down to the anal margin and suture it there and thus to form a fresh anus in its normal position. A third plan is to bring out the lower end of the rectum and suture it to the skin margin

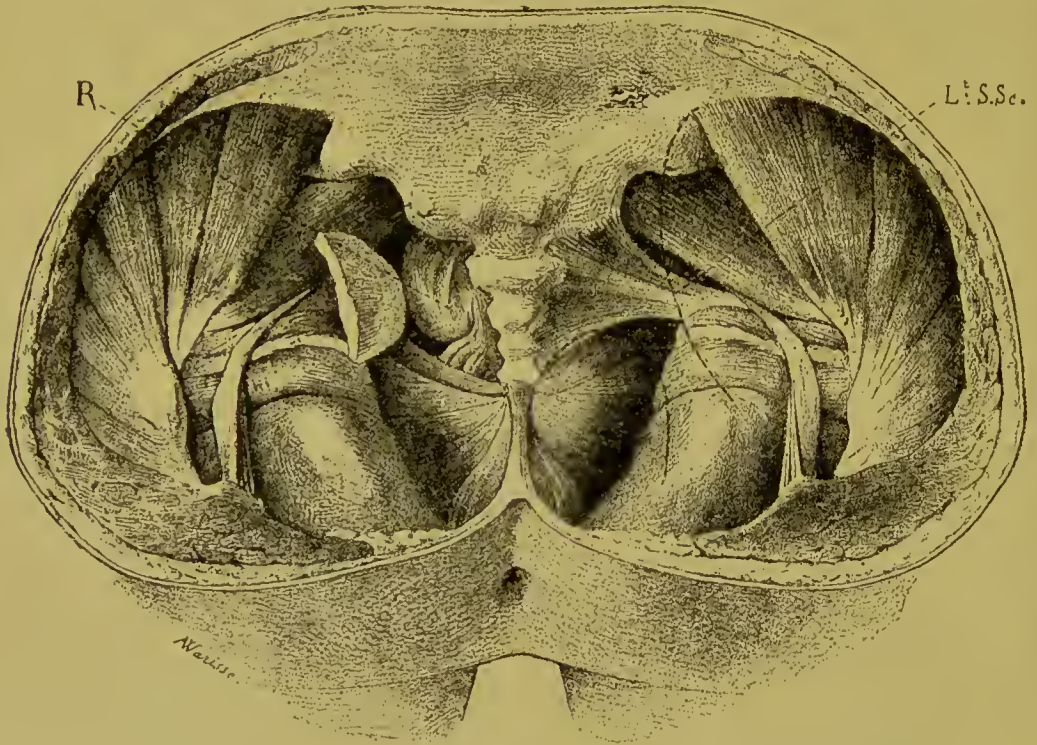


FIG. 20.—THE ANATOMY OF THE PARTS CONCERNED IN KRASKE'S OPERATION BEFORE REMOVAL OF THE COCCYX IN THE MALE.

R. Rectum.

L.S.Sc. Sacro-sciatic ligament (in dotted outline). (Hartmann and Quénu.)

immediately beneath the divided end of the sacrum, while the fourth plan, formerly adopted by some, is to leave the divided end of the rectum open at the bottom of the wound and pack the gap in the soft parts below it so as to form a cicatricial track from that point to the skin. Although we mention this last procedure we do not recommend it; it is only to be done in extreme emergencies because it results in an extensive and intractable stricture and causes great difficulty subsequently. We even doubt whether it should ever be done as, if so much rectum has to be taken away that it is impossible to bring the ends down to the skin anywhere, it will be better to invaginate the lower end of the rectum and suture it completely and then to perform an inguinal colotomy.

The restoration of the continuity of the bowel by end-to-end suture of the divided ends is theoretically the ideal plan but is practically not feasible in the great majority of cases. It is really only available when at least an inch of the rectum can be safely left above the internal sphincter ; otherwise there

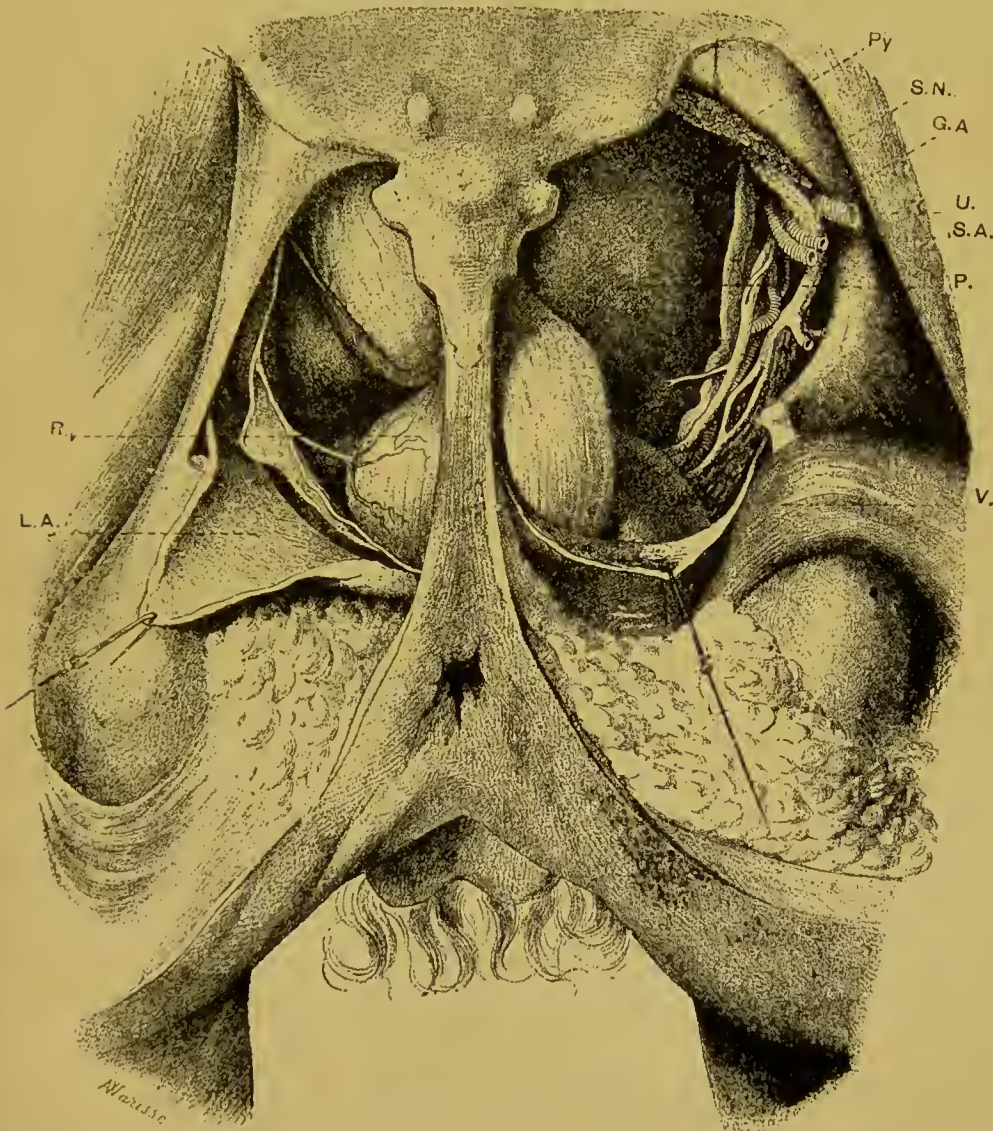


FIG. 21.—THE RELATIONS OF THE RECTUM IN THE FEMALE.

S.N. Great sciatic nerve.
S.A. Sciatic artery.
R. Rectum.

G.A. Gluteal artery.
P. Peritoneum.
L.A. Levator ani.

U. Ureter.
V. Vagina.
Py. Pyriformis.

(Hartmann and Quénu.)

is nothing to stitch the divided upper end to. As a matter of practice the two alternatives before the surgeon will nearly always be whether an artificial anus should be made below the sacrum or whether the rectum can be brought down and sutured to the anal margin. Of course the latter method is far preferable as the patient will then regain a certain amount of control.

When he has made up his mind how to treat the lower end of the bowel, the surgeon proceeds to clear the rectum above the tumour. In doing this

it must be remembered that the peritoneum in the male is reflected from the bladder on to the front of the rectum just above the level of the prostate and it gradually envelopes the bowel more completely until opposite the third sacral foramen there is an almost complete investment ; from thence upwards there is a true mesentery in which lies the inferior mesenteric artery giving off the superior hæmorrhoidal artery for the supply of the rectum. In dissecting out the bowel as little injury to the vessels as possible must be done, as otherwise sloughing of the lower end of the upper segment is very likely to occur.

The next point is to examine for glands in the hollow of the sacrum and to remove the fat and fascia with the glands contained in them as completely as possible from this region. It is at this stage that injury to the blood supply of the bowel is most likely to occur. It is necessary to caution the surgeon to carry out this separation as gently as possible. It has to be effected at the bottom of a deep wound, and, if the surgeon becomes impatient and pulls too forcibly upon the rectum, its walls, which are often thinned above the growth, may tear through, and very dangerous extravasation will take place into the pelvic cellular tissue.

After the rectum has been freed as completely as possible below the peritoneal reflection, the latter must be opened and the lateral reflections snipped through as far as may be necessary to allow the rectum to be pulled down. In dividing the peritoneal reflections care must be taken not to go too far back or the vascular supply of the bowel will be injured. If the pelvis be raised sufficiently there is no chance of the intestines prolapsing, and abdominal cloths may be packed in to shut off the peritoneal cavity, whilst the surgeon, having got the bowel sufficiently far down to enable him to divide it well clear of the growth, turns his attention to the treatment of the lower end.

If it be impossible to bring down the bowel above the line of section and suture it to the margin of the anus, the best plan is to encircle the latter by an elliptical incision and to dissect out the rectum below the growth until the whole of the segment to be removed is completely free. Before making the elliptical incision around the anus it is a good plan to invert the anal margin and to pass stout silk sutures through it (see p. 77) ; when tied these will close the anal orifice and their ends may be left long and grasped in forceps, a procedure that will facilitate the handling of the bowel without any danger of infecting the fingers. A bougie is now introduced into the bladder in the case of the male, or an assistant's finger into the vagina in the case of the female, and the parts are carefully separated by the finger and snips of the scissors from the prostate and base of the bladder in the male and the vaginal wall in the female. The attachment of the levator ani around the bowel should be carefully cut through as close to the rectal wall as the limits of the disease will allow.

An alternative plan is to divide the bowel transversely above the limit of the tumour first, and then to dissect out the lower end of the rectum from the

point of division down to the anus. If this method be chosen, it is best to apply stout tape ligatures, one on either side of the proposed line of section of

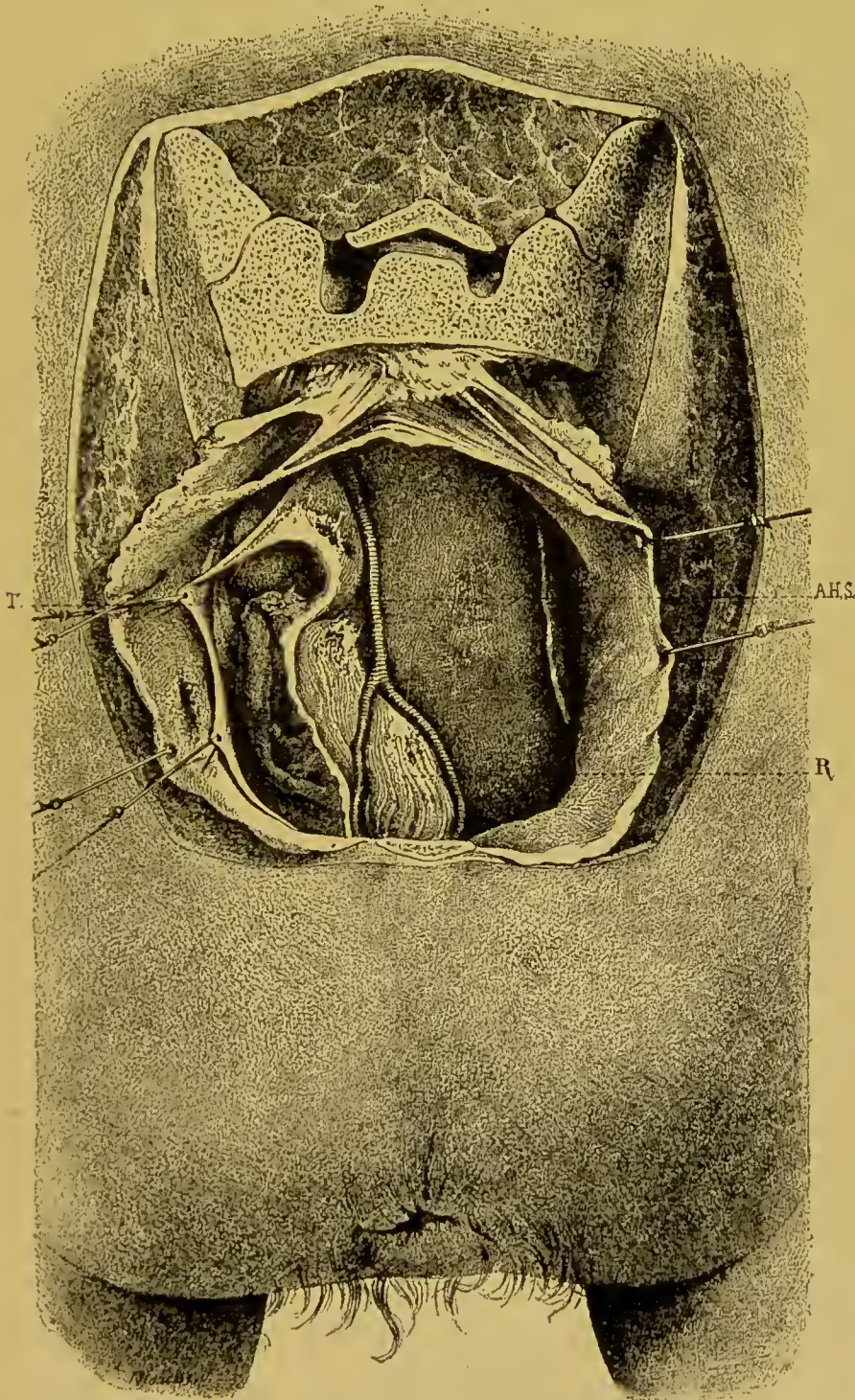


FIG. 22.—THE RELATIONS OF THE RECTUM IN THE FEMALE AFTER REMOVAL OF THE COCCYX AND PART OF THE SACRUM.

A.H.S. Sup. hæmorrhoidal artery.

R. Rectum.

T. Left Fallopian tube seen through an incision in the peritoneum, which is hooked back.

(Hartmann and Quénu.)

the bowel and, tying them firmly, to divide the gut between; the upper divided end with the ligature still attached to it is then covered with gauze, and held out of the way by an assistant, whilst the surgeon takes the tape attached to the divided end of the lower segment and dissects this downward to the anus. This plan has the advantage that it is easier to separate the bowel from the structures in front than when dissecting up from the perineum. It has the disadvantage, of course, that the cellular tissue may be soiled by escape of intestinal secretion when the division is made but, if the bowels have been previously kept thoroughly emptied, and if the soft parts beneath are packed off when the section is made, no harm results.

Attachment of the bowel in the sacral region.—Nothing now remains to be done but to bring down the divided upper end of the bowel and fasten it to the skin. The latter is slightly freed from the subjacent tissues at the lower end of the sacrum and the end of the rectum, still occluded by the ligature placed on it before division, is brought down and stitched to the margin of this. Before inserting the sutures it is well to adopt the plan introduced by Gersuny, who gives the rectum a half or three-quarter turn around its own long axis in order to render the escape of fæces more difficult. We have done this in several cases with very satisfactory results, and can highly recommend it. The twist should not be carried beyond a three-quarter turn at the outside, as otherwise the lumen will be interfered with too much. The rectal wall just above the ligature is now fastened to the skin by silkworm-gut stitches that do not penetrate the mucous membrane. The remainder of the wound below the new artificial anus is cleansed and sponged over with a solution of chloride of zinc (40 grs. to the oz.). Free drainage is necessary in case infection has occurred; a large drainage tube (No. 24) is inserted so that the end protrudes from the anal region, and the incision from the new artificial anus downwards is closed by silkworm-gut sutures inserted deeply so as to bring together the deeper parts of the wound as well as the skin edges; the latter may, if necessary, be further approximated by separate sutures.

The final point is the question of how the escape of intestinal contents shall be dealt with. Of course if this were allowed to take place freely over the wound septic infection would be inevitable, and serious pelvic cellulitis might ensue. We have tried two plans, and are satisfied with both. In the one the ligature, fastened around the bowel before it is divided, is left *in situ* until it separates spontaneously. By its means the lower end of the bowel is occluded completely for at least two days, so that neither fæces nor flatus pass, and there is therefore no infection of the wound during this period. By the time the ligature separates a sufficient barrier will probably be provided by nature against septic infection. The disadvantage of this plan is that, since flatus cannot escape, the patient may be considerably inconvenienced, but, if the bowel has been freely evacuated before the operation, this is not very serious, and is of course relieved immediately the ligature separates. The other, and perhaps the more convenient plan, although it takes slightly longer, is to substitute a large size Paul's tube for the ligature around the lower end

of the bowel. This should be introduced and tied in in the ordinary manner (see Part VI., Sec. I., p. 325), its end being plugged with a little cotton wool or a cork, until the dressing of the wound is complete, when the plug may be taken out and a length of indiarubber tubing fitted over the tube so as to convey the intestinal contents into a receptacle without fouling the wound or the dressings (see Fig 23). Through this tube the flatus escapes readily, and the patient therefore suffers absolutely no inconvenience. As a matter of fact faecal material rarely passes if the bowels have been sufficiently cleared out ; nothing much reaches the rectum until about the time when the

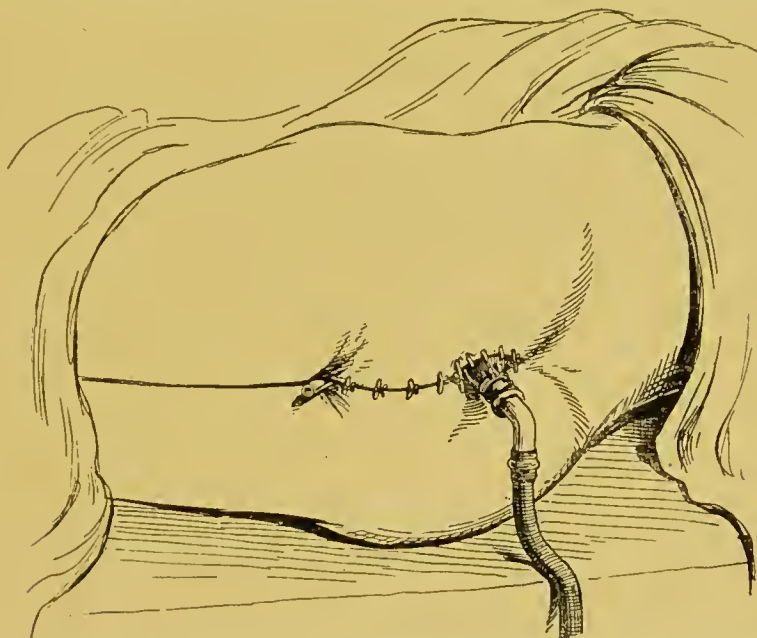


FIG. 23.—METHOD OF USING PAUL'S TUBE FOR EXCISION OF THE RECTUM. The bowel has been brought out beneath the edge of the sacrum and sutured to the skin there. A large drainage tube is inserted at the anal end of the incision and a Paul's tube is tied into the projecting end of the bowel.

ligature cuts through the bowel by ulceration, and the tube gets loose. If a Paul's tube be used in this way it should be introduced before the bowel is sutured to the skin below the sacrum. The end of the gut is pulled down by the tape fastened upon it, and the lumen of the bowel is occluded by an assistant's fingers as far above the line of section as possible ; the occluding tape is then removed from the cut end, and the Paul's tube is introduced in the usual manner and tied in with stout silk or fine tape. The bowel is then fixed to the skin as recommended above.

Considerable care is necessary in fastening the bowel to the margin of the skin ; while in cases of healing by granulation the opening of the artificial anus is often so narrow as to require subsequent dilatation or division, it not infrequently happens that in cases healing by primary union the opening is too patulous, and this is a frequent cause of prolapse, so that the surgeon must be careful that the orifice of the artificial anus is slightly less than the normal calibre of the bowel. The slight contraction involved in healing will probably reduce this somewhat so that an opening of suitable size results.

The great objection to the artificial anus in the sacral region is that it is difficult for the patient to manage for himself, so that he generally requires the services of an attendant. The faecal stream is projected backwards from the lower end of the rectum instead of directly downwards, and there is also some tendency to prolapse of the mucous membrane.

Attachment of the bowel in the anal region.—It sometimes happens that the artificial opening can be made in the position of the normal anus, and this is such a gain to the patient that it should always be done if possible. It is most likely to be feasible when the growth is low down in the bowel and it is unnecessary to take away more than a very small piece of the sacrum. The early stages of the operation are the same as those already described; when the surgeon has freed the bowel and finds that the divided end of the upper extremity can be made to reach the anus, an incision should be carried through the mucocutaneous margin of the anus, as in Whitehead's operation (see p. 51), and the mucous membrane and submucous tissues dissected up as far as the top of the internal sphincter. Here the muscular wall of the rectum is cut across, and the dissection of the lower end of the gut from the surrounding tissues is carried out as in Kraske's operation (see p. 82) as high up as may be necessary. The rectum is now pulled well down until the proposed line of section is on a level with the anus. The bowel is then given a half or three-quarter twist on its long axis (see p. 84), the portion containing the growth is cut away and the divided edge of the upper end is sutured to the anal margin. To avoid bleeding this is best done by removing the affected portion of the bowel by a series of short snips with the scissors and then suturing each portion divided in succession to the skin with interrupted sutures of stout catgut, the ends of which are left long. This method both insures accurate coaptation and checks the bleeding from the cut end of the bowel.

By this method the lower end of the rectum is not only joined to the skin in the normal situation of the anus, but its end is embraced by the internal sphincter so that more or less complete recovery of control may be looked for in suitable cases. The recovery of control is hardly complete, of course, because the nerve supply of the sphincter on the left side is apt to be interfered with during the operation, but if the half twist be given to the bowel the activity of the sphincter on the right side, combined with this gives very nearly complete control, and the method is an ideal one; the pity is that it is only feasible in a small number of cases.

End-to-end union of the segments of the bowel.—In the rare cases where the growth is so small that only a limited part of the rectum has to be removed, and where in addition the situation is such that there is enough healthy rectum left below the growth to enable the ends to be brought together, the union may be effected in several ways. In our opinion the best plan is a modification of the one just described; the mucous membrane of the open end of the lower portion of the bowel is dissected off for about half an inch

and into this collar of denuded muscular wall the lower end of the upper segment is passed and secured by a series of Lembert sutures. In our opinion this gives a much better union than the ordinary form of end-to-end anastomosis.

It is most important that the surgeon should not endeavour to adopt either of the last two methods unless he is sure that the conditions are favourable. If there be much tension on the upper end of the rectum when attempts are made either to approximate it to the lower portion, or to bring it down to the anal margin, it is far safer to bring the open end out beneath the sacrum and to make an artificial anus there, as the traction required to bring it into one of the other positions will either so endanger its blood supply as to give rise to sloughing of the posterior wall, which is apt to be followed by spreading pelvic cellulitis, or else the stitches will cut through and a very troublesome band of cicatricial tissue will form across the lumen of the bowel.

After-treatment.—A dose of opium is administered after the operation and, if the latter has been long and severe, measures against shock may be required (see Part I., p. 139). When the rectum has been sutured beneath the sacrum, the bowels should be kept confined as long as possible so that the healing of the wound may be fairly advanced when the first action occurs. Before this happens, all deep stitches should be removed so as to avoid infection along the stitch tracks, and any portion of the wound that is left open should be carefully covered with gauze so as to prevent infection; if no septic infection has occurred, the drainage tube should also be removed. The dressings after this should be changed three or four times daily. After the outer pad of dressing is removed, any faecal material is washed away by irrigating with boracic lotion, after which the deeper dressing is changed. With an intelligent nurse the case will often follow an almost entirely aseptic course. Should primary union occur, the patient will be well in three or four weeks; if any large amount of the wound has to heal by granulation six weeks or more may elapse before he can get about. He should first wear a pad fastened on with a T-bandage, but when the parts are quite sound he may be provided with a suitable truss with a plug fitting the artificial anus. After an operation done in this manner the patient is usually comfortable as long as the bowels are not relaxed. If an hour or so each morning be devoted to ensuring a complete evacuation of the bowels and to thorough cleansing of the parts, the patient goes through the rest of the day without inconvenience; after the lapse of a considerable period he may even dispense with a plug as considerable control may be regained; indeed, unless there be an attack of diarrhoea, there is very little incontinence. The circular fibres of the bowel assume a certain amount of sphincteric action after some time.

When the bowel has either been sutured to the anal margin or an end-to-end union has been effected, thorough drainage must be provided for

the wound in case any portion of the union gives way and faecal extravasation occurs. The best plan is to leave the wound well open and to pack it with strips of iodoformed gauze for a few days. When granulation is fully established, the edges of the wound may be brought together by deep stitches if there be no sepsis, a drainage tube being inserted to carry off any discharges. The bowels should be kept confined as long as possible and, after they have been made to act, they should be kept acting regularly every day.

2. Excision by the perineal route.—This, the old method, was the one always employed until the introduction of Kocher's and Kraske's operations but for many reasons it is bad. The operation is done through an incision from the anus to the tip of the coccyx and the result is that it is difficult to see what is being done and to properly secure the bleeding points. The greatest drawback however is that the operation as usually done leaves several inches of raw granulating surface below the open end of the rectum and the result is that there is not only a risk of sepsis, but severe pain accompanies defæcation, while the constant passage of bougies is necessary to maintain the patency of the opening, and finally a stricture of the most intractable kind results. In the perineal operation it is very difficult to make sure that the line of section is well above the growth and the surgeon is almost invariably tempted to do too little rather than too much; moreover there cannot be the same satisfactory removal of glands. In certain cases however the operation is undoubtedly the one of selection; it should be limited to those of growth at or in immediate proximity to the anal orifice. It is best done as follows:

The patient is placed in the lithotomy position and a median incision is made from the tip of the coccyx to the mid-point of the perineum, diverging on each side at the posterior margin of the anus to enclose the latter in an elliptical incision either along the muco-cutaneous margin or further out upon the skin if the growth encroaches upon this situation. The incision from the anus to the coccyx should be carried deep into the hollow of the sacrum; a large sponge thrust into it will check hæmorrhage. The forefinger of the left hand is introduced into the rectum the limits of which are defined and the gut is dissected from the surrounding structures with scissors, the thumb being used to retract the bowel. Much can be done with the closed blades of the scissors, the structures being snipped through where necessary and bleeding points picked up with forceps. The separation of the bowel, especially behind and on either side, as far as the levator ani is easily accomplished: the connection in front with the vagina or the prostate and urethra is very intimate and great care must be taken. A finger in the vagina or a large sound in the male bladder will help the finger in the rectum to define the latter structure efficiently. The entire wall of the bowel must be dissected up and not the mucous membrane only.

The next step is to divide the levatores ani all round (see Fig. 24) and this should be done slowly, any vessels being picked up as they are divided. The

rectum can now be pulled down more freely, the limits of the disease ascertained and the bowel further isolated. The separation must be done

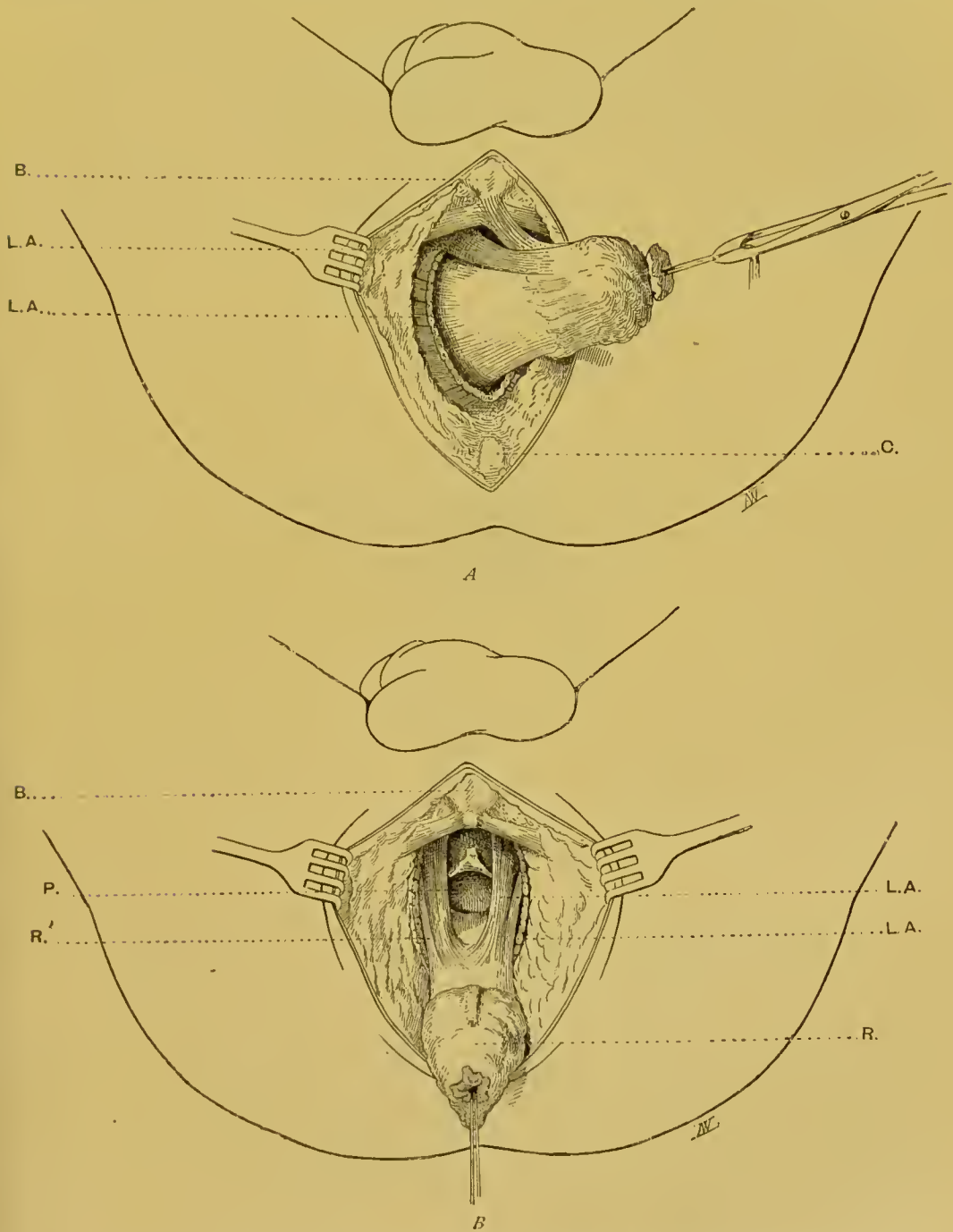


FIG. 24. -DIVISION OF THE LEVATOR ANI IN EXCISION OF THE RECTUM BY THE PERINEAL ROUTE. In *A* the sphincteric area has been freed and the lateral fasciculi of the levatores have been cut through. There remain the anterior bundles, which are put on the stretch and divided, as shown in *B*

C. Coccyx.
P. Prostate.

B. Bulb.
R. Rectum.

L.A. Levator ani.
(Hartmann and Quénu.)

very carefully in front, chiefly with the right forefinger, so as to strip up the peritoneum unopened. Should the cul-de-sac be opened, a tampon of

gauze may be thrust in and the isolation of the bowel proceeded with but, before dividing the rectum above the growth, it is well to stitch the parietal peritoneum to the sero-muscular coat of the rectum by a few fine catgut stitches and a Hagedorn needle. Before this is done, the bowel must be drawn down to the position it will occupy after the affected portion has been excised. The gut is then cut across by a series of snips with the scissors and any vessels that spurt are picked up and twisted or tied.

The next point is how to treat the cut end of the bowel. Some surgeons leave it in position at the top of the wound and allow the raw

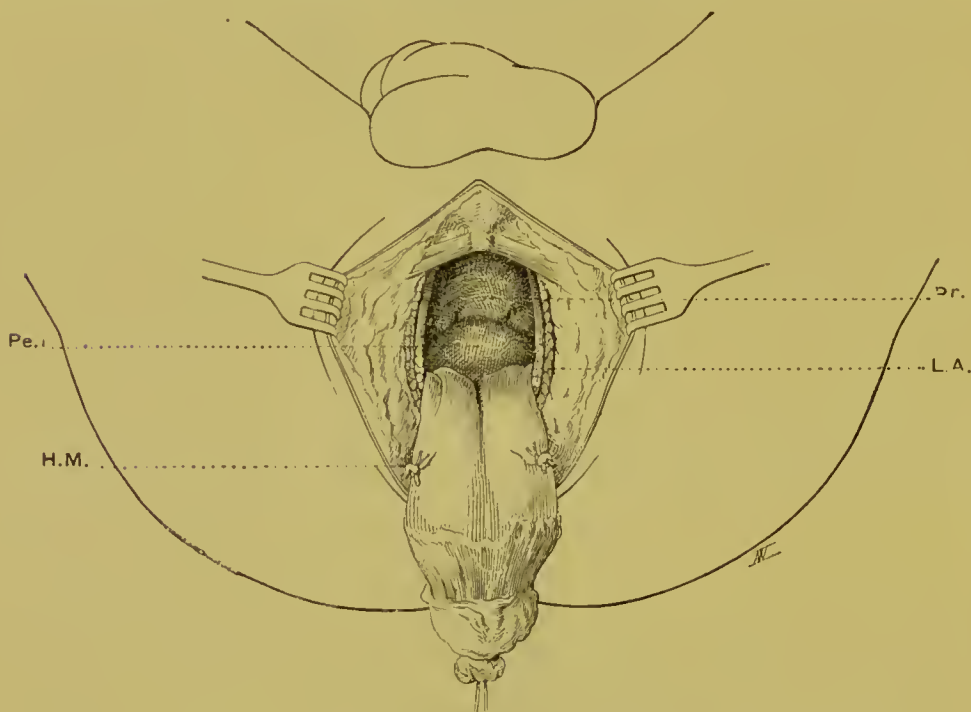


FIG. 25.—SEPARATION OF THE PERITONEUM FROM THE FRONT OF THE RECTUM IN PERINEAL EXCISION. The levatores ani have been divided, the middle hæmorrhoidal arteries tied, and the bowel separated from the prostate.

Pr.	Prostate.	Pe.	Peritoneum.	H.M.	Middle hæmorrhoidal artery.
L.A.	Levator ani (divided).				(Hartmann and Quénu.)

surface below it to heal by granulation, while others bring it down and stitch it to the skin margin. We are strongly of opinion that the latter course should be adopted wherever possible and, as we only recommend this operation for growths in the immediate neighbourhood of the anus, it should be quite feasible in the majority of cases. We would go so far as to recommend extra freeing of the bowel above the growth if necessary to effect it, or even opening the peritoneum freely and dividing its lateral reflections (see Fig. 26), the peritoneum being afterwards sutured to the bowel before the latter is cut across. We are not at all inclined to think that such a procedure renders sepsis more common. Free division of the lateral peritoneal reflections will obviate any risk of the bowel receding in any case suited for this operation. To our minds saving the patient from

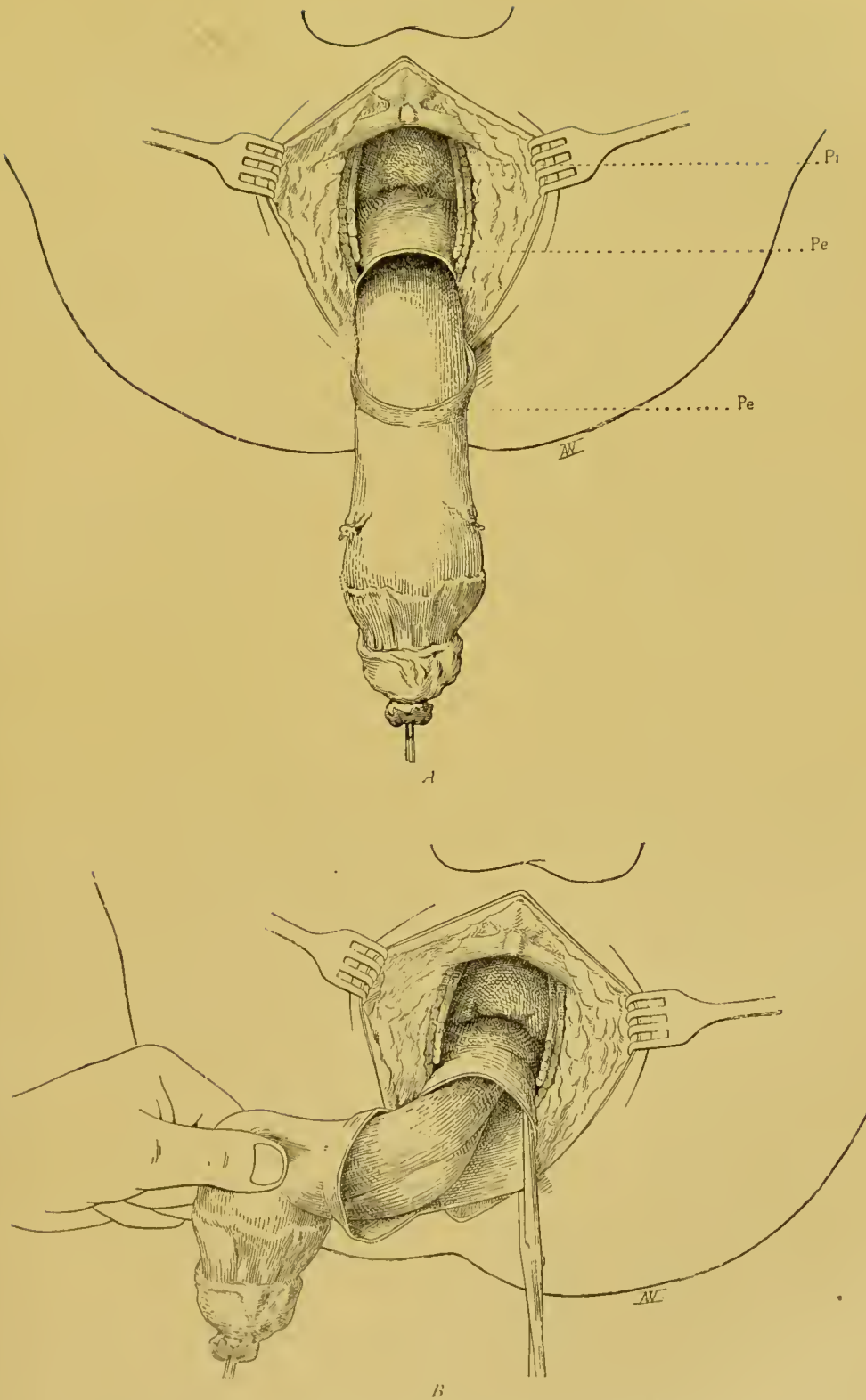


FIG. 26.—TREATMENT OF THE PERITONEUM IN PERINEAL EXCISION OF THE RECTUM. In *A* the peritoneal cul-de-sac has been opened, while in *B* the lateral reflections are freely divided, allowing the bowel to be drawn well down. Before the rectum is cut across above the growth the cut edge of the peritoneum (held in forceps in the figure) is sutured to the sero-muscular coats of the bowel as it is held in the position depicted above.
(Hartmann and Quénu.)

the excessive suffering caused by the slow granulation of the perineal wound and the subsequent stricture far outweighs any possible disadvantages.

A suppository is introduced into the bowel and a gauze dressing applied and kept in position by a T-bandage. The *after-treatment* will vary according to the manner in which the end of the bowel is treated. When the mucous membrane has been brought down to the skin, the after-treatment is identical with that of Whitehead's operation for piles (see p. 51). Should a large raw surface be left, however, the wound should be packed with strips of muslin saturated with eucalyptus ointment, and this will require changing daily or even oftener. The bowels should be confined for the first four or five days, after which they may be opened every alternate day by a suitable laxative. Healing by granulation usually takes twelve weeks or more and in the later stages it will be necessary to pass a well-oiled bougie every few days in order to prevent contraction.

3. Excision through the vagina.—Very excellent results may be obtained by operating by this route in cases of malignant disease in the female comparatively low down. The patient is placed in the lithotomy position, the vagina is thoroughly douched with 1-2000 sublimate, and the perineum is divided in the middle line from the posterior commissure of the vagina back to the external sphincter, but not through it; the forward end of the incision is then carried up the posterior wall of the vagina nearly to the cul-de-sac. When the tumour does not infiltrate the vaginal wall, the latter is easily turned back on each side and the rectal wall exposed; when there is any infiltration of the vaginal wall, an elliptical portion of the latter should be removed. The rectum is defined and the surrounding structures are stripped off it with the finger and a blunt dissector. The levator ani is divided on each side, and the reflection of the peritoneum, if well above the growth, may be pushed up with the handle of the knife, or, if not, may be opened and the lateral reflections divided. The rectum is then gradually isolated, and the glands and fat in the hollow of the sacrum are also removed; if there be sufficient healthy bowel below the tumour, the anus is dilated, an incision is made around the muco-cutaneous margin, as in Whitehead's operation (see p. 51), the mucous membrane is dissected off the sphincters, and then the whole thickness of the muscular wall of the rectum is divided at the level of the upper border of the internal sphincter. The mucous membrane already dissected up from the lower part of the rectum is then seized in catch forceps and pulled down through the anus, and the upper end is freed so that; when the growth is removed, the cut end can be brought through the sphincters and stitched to the anus; if necessary the skin at the anal margin can be loosened and pulled in, so as to reach the mucous membrane. In stitching up the incision in the vaginal wall at the end of the operation, it is well to carry the stitches through the muscular coat of the bowel also; they thus hold the bowel down in position and prevent dragging on the anal sutures. The perineum is then repaired and the

operation is complete. The wound should heal by first intention and the patient be well in the course of a fortnight or so. In the first case in which we performed this operation, now three or four years ago, the patient recovered complete control and has remained well; union took place with the greatest readiness.

4. Excision partly or entirely through the abdomen.—There remains the abdominal route for the removal of cancer of the rectum. Excision may occasionally be effected entirely through the abdomen, the continuity of the bowel being restored by end-to-end suture; but this is rare, and is only possible when the growth is so high up in the rectum that it is practically in the sigmoid flexure, or when the rectum has an unduly long meso-rectum. The operation is the same as for excision of a malignant growth in the large intestine elsewhere (see Part VI., Sec. I., p. 354).

In other cases the growth in the rectum is sufficiently high up to be removed from a laparotomy wound, but end-to-end suture is practically impossible, owing to the want of mobility and comparative depth of the lower segment. Here an important question is, what should be done with the divided ends; it may be advisable either to bring out the proximal end of the rectum and establish an inguinal colotomy, or to sew up the end and make a separate colotomy wound, the open end of the distal portion in either case being invaginated and sutured so as to entirely occlude it.

Recently a method which combines removal by the abdominal and the sacral routes has been much advocated by French surgeons, particularly by Quénu, who terms the operation “extirpation of the rectum by the perineo-abdominal route.” The operation essentially consists in opening the abdomen by a median sub-umbilical incision, ligaturing both internal iliac arteries, dividing the sigmoid flexure across, temporarily occluding both ends so as to prevent septic contamination, and then bringing out the proximal end through an inguinal colotomy wound, while the meso-sigmoid and meso-rectum of the distal portion are rapidly divided between either ligatures or clamps, until the rectum is free as far down as can be reached from above. The distal segment thus freed is now packed down into the pelvis by two abdominal compresses, the vessels ligatured and the abdominal wound stitched up; the patient is then turned over, and the rest of the operation completed through a sacral incision similar to Kraske’s. The rectum is exposed from the lower end until the peritoneal reflection is opened, when the portion already freed from its meso-rectum is found lying in the pelvis, together with the abdominal compresses; these are pulled out and the entire lower segment dissected away. The sacral wound is partly sutured, the opening in the perineum is plugged with gauze, drainage is provided, and antiseptic dressings are applied outside.

This operation, though excellent in theory, is undoubtedly accompanied

not only by considerable hæmorrhage but by excessive shock and even by a risk of sepsis. A most interesting fact is seen in Quénu's figures, namely, that nine women were operated on with eight successes and one death, while all the seven cases in which the operation was performed on men terminated fatally. We cannot help thinking that this somewhat heroic operation will not find general favour. Cases calling for entire extirpation of the rectum with removal of enlarged glands in the hollow of the sacrum are probably cases which are better not submitted to excision, while those that are really suited for excision are to our minds equally well off if the operation practised by Kraske or some modification of it, followed if necessary at a subsequent period by the establishment of an inguinal colotomy, be performed.

DIVISION II.

THE SURGICAL AFFECTIONS OF THE PANCREAS, LIVER, AND SPLEEN.

CHAPTER XI.

THE SURGICAL AFFECTIONS OF THE PANCREAS.

INJURIES OF THE PANCREAS.

THESE are comparatively rare and of no great surgical importance because they are practically never the sole lesion. The position of the pancreas is such that injury to it must almost certainly be accompanied by others such as rupture of the stomach, liver or spleen, whether the pancreas be contused by a direct blow or a run-over injury or penetrated by a sharp instrument or a bullet. The injury to the organ is generally only recognised in the course of operative interference for a severe abdominal injury, although, in the case of penetrating or bullet wounds, it may be suspected from the direction of the wound. Hence the importance of the cases lies chiefly in the fact that the surgeon should bear the possibility of their occurrence in mind when he has to deal with a general abdominal injury; he should more especially remember the likelihood of bleeding coming from the large vessels about the pancreas when the abdomen has been opened for hæmorrhage.

The pancreas may be bruised, ruptured or so damaged that gangrene may follow, or its vessels may be torn and there may be bleeding into its substance, beneath its capsule or, still worse, into the general abdominal cavity. Acute pancreatitis may follow an injury and may end in suppuration and general pyæmia, or the more chronic form may ensue. Blood-cysts may also form, and contusion is one of the common causes of a pancreatic cyst (see p. 98).

TREATMENT.—There is little to say concerning the treatment of injuries of the pancreas *per se*. Should the abdomen be opened for severe

internal bleeding and should the source of hæmorrhage be difficult to determine, the pancreas must not be omitted from examination and, if hæmorrhage from it be found, the bleeding point must be secured and under-run with catgut if possible, or long-handled forceps may be left on the bleeding point for 24 hours. The handles are made to emerge from the abdominal wound which is sutured tightly around them, and a gauze dressing is applied over all. At the end of 24 hours the dressing is removed, the handles are cautiously separated and the forceps removed. A loose suture should be inserted at the time of the operation through the gap left for the emergence of the forceps and this should be tied when the latter are removed. The best mode of gaining access to the pancreas is probably to tear through the omentum between the stomach and the transverse colon.

Any collection of blood in or around the pancreas should be evacuated, so as to avoid the subsequent formation of a blood-cyst. When there is extensive crushing of the organ, it will probably be best to provide free drainage both by tubes and by packing the wound with iodoformed gauze, so that, should gangrene occur, there will be a free exit which is shut off from the peritoneal cavity.

Among other lesions resulting from injuries to the pancreas accompanied by wounds, a traumatic hernia or prolapse of the organ has been met with. Should one of these rare cases come under notice, the prolapsed portion should be thoroughly cleansed and reduced and a drainage tube or gauze packing should be inserted down to the bottom of the wound.

INFLAMMATORY AFFECTIONS OF THE PANCREAS.

Both acute and chronic inflammation of the pancreas are known, but, although extremely important they are very difficult conditions either to diagnose or to treat.

ACUTE PANCREATITIS is rarely diagnosed during life, although successful treatment has been adopted in a few instances. The difficulty in diagnosis is that the symptoms closely simulate either acute peritonitis or acute intestinal obstruction. The affection is characterised by intense pain and vomiting, accompanied by severe collapse, frequent pulse, marked tympanites and some pyrexia, with a variable amount of constipation. These cases have been operated on under the impression that they were either acute peritonitis or internal strangulation, and even then the true condition has not always been recognised until a *post-mortem* examination has been made. The sequelæ of acute pancreatitis may be gangrene, hæmorrhage into the pancreas, necrosis or suppuration, the last of which is the only condition which concerns us from the surgical point of view.

Acute pancreatic suppuration may occur either in or around the organ, and may be localised, or may take the form of a diffuse infiltration of the pancreatic tissues with pus, forming disseminated abscesses later on. In the latter case the affection is pyæmic, and here the true diagnosis

will probably not be made or, if made, cannot lead to any satisfactory practical result. The only condition for which surgical intervention offers any hope is that of circumscribed abscess either in or around the pancreas. In these cases, too, the diagnosis is extremely difficult. At the onset there are symptoms of acute pancreatitis followed by localised pain and tenderness in the epigastrium, with the formation of a tumour in the region of the pancreas, frequently accompanied by symptoms referable to organs such as the stomach or the liver in the immediate neighbourhood, jaundice not being infrequent. The prognosis is very bad.

Treatment.—In a few instances abscesses of the pancreas have been successfully treated by drainage. The best plan is to reach them from the front through a median laparotomy wound above the umbilicus, and then to tear through the gastro-colic omentum, taking care not to wound any large vessels. When the abscess is reached it is opened by a small incision in the first instance, after the most careful packing off of the surrounding peritoneal cavity, in order to prevent the abdomen being flooded with pus. A retro-peritoneal opening of the abscess has been practised through a lumbar incision, but it is very difficult to cut down from the loin directly on to an abscess in the pancreas, more particularly when the diagnosis is as uncertain as it generally is, and the best plan appears to us to be to open it first from the front, and to ascertain subsequently by means of a long probe or the finger, whether the cavity projects into the loin, and whether, therefore, it is possible to reach it by a lumbar incision, whereby more satisfactory drainage can be secured than is possible when the cavity drains through the anterior abdominal wall. If so, the point of the probe is cut down upon from behind, and large drainage tubes are inserted, while a single large tube, packed round with gauze, is placed in the anterior opening and allowed to emerge through the abdominal incision. When adhesions have occurred around this, both the tube and the packing are withdrawn, and the front wound is allowed to heal, while drainage is effected satisfactorily through the posterior opening.

CHRONIC PANCREATITIS.—The chief importance of this affection is the difficulty in diagnosing it from malignant disease. The condition occurs chiefly in connection with calculi in the pancreatic duct with some diffuse inflammatory affection of the organ, or possibly after an injury.

Symptoms.—These are very indefinite. The most marked are dyspeptic troubles, irregularity of the bowels, loss of flesh and strength, accompanied by pain in the epigastrium, and sometimes jaundice when the head of the pancreas is affected and the common bile duct is pressed upon. The importance of the condition is the knowledge that this affection, which is a recoverable one, may easily be confounded, even after careful examination through a laparotomy wound, with cancer of the pancreas which, of course, is necessarily fatal. It has happened that cases diagnosed as cancer of the pancreas, where the abdomen has been

opened and cholecystenterostomy has been done for the relief of persistent jaundice, have recovered, the probable explanation being that the case was one of chronic pancreatitis.

Treatment.—The only surgical treatment beyond mere exposure for diagnostic purposes, which apparently sometimes does good, is the operation of cholecystenterostomy for the relief of the severe jaundice that occurs when there is pressure on the common bile duct and, as we have said, this operation is sometimes followed by recovery. Cholecystenterostomy is described in connection with the affections of the bile ducts (see Chap. XV.).

CALCULI IN THE PANCREAS.

These consist essentially of phosphate and carbonate of lime; they lie in the duct and cause a marked alteration in the pancreatic tissues which sometimes takes the form of fatty degeneration, whilst at others it manifests itself as a chronic pancreatitis. Usually also the duct is dilated behind the calculi and a cystic swelling is formed.

The etiology of these concretions is not clear. Probably some alteration in the consistency of the secretion or some interference with its flow or the presence of mucus in it may facilitate their formation. The diagnosis is almost impossible without exposure of the pancreas. The chief symptom is pain, which is either continuous or colicky and is most frequently referred to other organs, such as the liver. There may be pyrexia, and diabetes is not uncommon, and it is just possible that the presence of colicky pains in the neighbourhood of the pancreas together with the presence of sugar in the urine may lead to the diagnosis. When the obstruction is complete, fatty stools occur and sometimes jaundice is present when the calculus presses upon the common bile duct. As a rule however it is only after a laparotomy that the stone is diagnosed, and even then it may lie in the head of the pancreas in the midst of a mass of cicatricial tissue, so that a diagnosis of malignant disease is made. Should the presence of a stone be recognised however, there is no reason why it should not be removed by making an incision directly over it, extracting the stone and then subsequently stitching up the incision and providing free drainage through the anterior abdominal wall by means of a large-sized drainage tube packed around with gauze, so that pancreatic secretions shall not accumulate in the neighbourhood and there shall be no risk of necrosis.

PANCREATIC CYSTS.

The origin of these cysts is not yet clear. Occasionally they seem to definitely follow an injury, when they are probably due to a collection of blood in the first instance; at other times they may follow inflammatory phenomena and occasionally also they arise without any known cause and are only detected when they have attained a considerable size. They are met

with at all ages but are most frequent between twenty and forty years of age.



FIG. 27.—DIAGRAMS SHOWING THE DIRECTION TAKEN BY A PANCREATIC CYST. In *A* the cyst comes forwards above the transverse meso-colon, in *B* and *C* in the layers of this structure, while in yet another variety it may pass entirely below it. In *D* it is situated between the liver and the stomach.

The true blood-cyst usually follows an injury which is not sufficiently severe to cause death; at a varying interval afterwards the presence of a cystic tumour in the situation of the pancreas is noticed. All cysts containing blood-stained fluid however must not be looked upon as having

originated from an injury, as they occasionally arise spontaneously, and it is not uncommon to find blood in cysts which have an entirely non-traumatic origin.

The fluid in a pancreatic cyst is nearly always slightly blood-stained and shows albumen, urea and cholesterin; it is very rarely pure pancreatic fluid. It is almost always alkaline, is generally somewhat tenacious and slimy and its specific gravity varies from 1010 to 1020; sugar may be present. The cysts may occur anywhere in the gland but are said to be more frequent in the neighbourhood of its tail. They are all retro-peritoneal and as they increase in size they push forward the lesser peritoneal cavity until at last the anterior wall of the cyst comes into close proximity with the anterior abdominal parietes. The exact relation of the cyst to the stomach and intestines varies in different cases (see Fig. 27). The commonest condition is for the cyst to find its way forward between the stomach and transverse colon, the former being pressed up against the liver and the cyst wall being covered by the anterior layer of the gastro-colic omentum. On the other hand, the cyst may find its way below the transverse meso-colon or indeed above the stomach. A large cyst may cause serious pressure upon the duodenum, the common bile duct, the aorta, the vena cava or the portal vein and in addition there will be pain from pressure on the solar plexus. The cyst is scarcely at all mobile, in any case only the projecting portion moves with respiration; transmitted pulsation from the aorta may be very marked. The cyst is usually median; but it may lie to the left or, more rarely, to the right of the middle line.

SYMPTOMS.—The symptoms are usually indefinite; there is dyspepsia and pain, and true pancreatic symptoms, *e.g.* wasting, glycosuria, undigested fat in the stools or diarrhoea may arise if the cyst be large, but these may be entirely wanting. The cyst is usually globular, smooth and very tense and may be mistaken for a solid tumour. It may vary in size, apparently emptying and then re-filling; whether it empties by rupture or by absorption of the fluid is not clear. If left alone, it will ultimately rupture either into the alimentary canal or into the peritoneal cavity, and then recovery may take place. Death however may occur from obstruction, from hæmorrhage, from peritonitis, from profound jaundice, from diabetes, or from wasting, and these cysts are accompanied by much more marked emaciation and loss of strength than are other cysts, such as hydatids, found in the same region.

The cyst has to be distinguished from one of ovarian or hepatic origin, from hydatids, from an enlarged gall-bladder or spleen, from hydro-nephrosis, hydatid or hæmorrhagic cysts of the kidney, from aneurysm and from mesenteric cysts. Any attempt to make the diagnosis by puncture is to be condemned, as the needle is very apt to traverse either the stomach or the colon. Puncture should only be carried out, if at all, after exposure of the cyst by opening the abdomen; as a diagnostic measure it is quite unnecessary.

TREATMENT.—This must be surgical, and may take the form of repeated tapplings, of incision and drainage, or of extirpation of the cyst. Puncture, as we have already said, is to be avoided; apart from the risk, the cyst will fill up again almost immediately. The first step, therefore, in all cases is to open the abdomen in the middle line over the most prominent part of the swelling and to expose the cyst wall.

As the position of the cyst relative to the stomach and the colon varies in different cases, these structures must be identified before proceeding further. In the ordinary form, where the tumour makes its way forwards between these two structures, the great omentum is carefully torn through and the stomach and colon are separated until the thin bluish cyst wall is exposed, any vessels wounded in the process being tied. The abdominal cavity must be packed off with gauze, and a fine trochar and cannula is introduced into the cyst and the bulk of the fluid drawn off so as to avoid flooding the abdominal cavity. The cyst is then opened by a small incision, the edges of which are caught in forceps, pulled well up into the wound, and sutured to the abdominal incision after the gauze packing has been removed. A drainage tube nearly fitting the opening in the cyst wall is introduced and an antiseptic dressing applied.

Sometimes the skin is irritated by the secretion from the cyst, especially in cases of true pancreatic cyst. This is best avoided by using a drainage tube large enough to fit the opening into the cyst tightly and connecting it with tubing which passes through the dressing into a vessel containing carbolic acid, thereby preventing contact of the secretion with the skin; failing this, the latter may be smeared over thickly with boracic ointment. When the cyst cannot be brought up sufficiently to be stitched to the skin, a drainage tube is introduced and packed round with gauze so as to prevent the escape of fluid into the abdominal cavity, the packing being removed in 48 hours, just as in the case of an abdominal abscess which has not yet become adherent to the anterior wall (see Part VI., Sec. I., p. 395). In some cases the finger may be passed into the loin through the incision and a counter-opening made beneath the costal margin, preferably on the left side; through this a drainage tube is introduced into the cyst, and the opening in the anterior wall of the cyst is then sewn up.

Healing is usually slow, and takes from one to four months. The mortality is quite small, up to the present time only about 4 per cent. The patient generally recovers quickly after the operation. The stomach troubles disappear and improvement in nutrition takes place, even when thin pancreatic juice is running out of the fistula.

The real radical treatment is extirpation of the cyst, but this is only possible in true cysts and not in retention cysts, as some of these are. Apart from the difficulty of getting properly at the cyst, serious bleeding is apt to occur and damage may be done to important structures, so that, unless the cyst be almost pedunculated, it is better not to attempt it; adhesions between the cyst and neighbouring structures will prohibit the attempt.

NEW GROWTHS OF THE PANCREAS.

Tumours of the pancreas are not uncommon, the great majority belonging to the class of carcinomata. Other tumours, such as adenomata, or, very rarely, sarcomata may also be found. The surgical treatment of these tumours is practically *nil*. The most frequent seat of carcinoma of the pancreas is the head of the gland, and it may then compress the bile duct and lead to jaundice. Should this be the case, cholecystenterostomy—connecting the gall-bladder with the duodenum—may give relief (see p. 151). When the tumour is large and compresses the pylorus, gastroenterostomy may be called for; but these growths generally extend rapidly and are accompanied by great pain, and it is questionable whether it is worth while interfering. Attempts have been made to remove the tumour and, when this is in the tail of the pancreas and is movable, it may be possible to do so. Tumours in the head of the pancreas practically involve total extirpation of the gland, and this is well-nigh impossible. Encapsuled tumours have been removed by tearing through the gastro-colic omentum, opening up the peritoneum over the gland and shelling out the growth.

NOTE.—For further information upon the interesting subject of affections of the pancreas, the reader may refer to the excellent work upon *The Diseases of the Pancreas*, by Robson and Moynihan (London, Saunders & Co.), published since the above was in print.

CHAPTER XII.

TRAUMATIC AFFECTIONS OF THE LIVER AND BILE PASSAGES.

SURGICAL ANATOMY OF THE LIVER.

THE inferior margin of the liver corresponds on the right side to the costal margin,¹ and crosses the epigastrium from the tip of the ninth right to that of the eighth left costal cartilage, crossing the linea alba nearly midway between the sternum and the umbilicus, and passing upwards and to the left to reach a point about the apex beat. The level of the upper surface may be denoted by a line from the base of the xiphoid cartilage to the right fifth rib in the nipple line, running thence to the sixth rib in the mid-axillary line and further back to the eighth dorsal spine.

The limits of the right pleural cavity are of importance, especially when puncturing the liver or opening abscesses. In front, the pleura descends to just behind the right seventh costal cartilage near the sternum, whilst in the right axillary line it descends to a level two or three inches above the costal margin. Behind, it may extend just below the twelfth rib. By removing the tenth rib in the axillary line the pleura can be avoided and the diaphragm at once exposed.

The relation of the peritoneum to the liver is also of importance. The organ is not covered by peritoneum posteriorly, and an abscess may therefore be reached there without traversing the peritoneal cavity. The peritoneum is reflected from the under surface of the diaphragm on to the convexity of the liver posteriorly as the anterior layer of the coronary ligament and passes round the inferior margin until it reaches the transverse fissure, when it is reflected downwards in front of the structures in the portal fissure to form the anterior layer of the gastro-hepatic omentum.²

¹The level of the inferior margin is often much lower than this, especially in old people. It may reach an inch or more below the edge of the ribs.

²To the right of the portal fissure it becomes continuous with the peritoneum in front of the right kidney—sometimes called the “hepato-renal ligament.”

The posterior layer of the gastro-hepatic omentum traced upwards is reflected on to the liver at the posterior margin of the portal fissure. Thence it passes upwards, covering the caudate and Spigelian lobes.

The liver has five ligaments, termed the coronary, suspensory or falciform, the round, and the right and left lateral ligaments. Of these the suspensory ligament is the only one of surgical importance as it serves to limit abscesses in the sub-phrenic region; it extends from front to back, and is continuous behind with the coronary ligament and wraps around the round ligament below. It consists of two opposed surfaces of peritoneum, and extends from the umbilicus, being reflected above on to the anterior abdominal wall and the diaphragm; it lies a little to the right of the middle line.

There is a well-defined area of the peritoneum shut off from the general peritoneal cavity between the liver and the transverse colon, which lies directly in contact with the anterior abdominal wall, and extravasations from the liver may therefore be limited to this area without affecting the general peritoneal cavity, provided that the extravasation be slow enough to give rise to adhesions which will still more effectually limit this space; an extravasation in this area will find its way downwards towards the right, outside the ascending colon.

SURGICAL ANATOMY OF THE GALL-BLADDER AND BILE DUCTS.

The position of the gall-bladder and its relation to other important structures in its immediate neighbourhood varies widely. When in its usual position, the fundus lies directly behind the ninth or tenth right costal cartilage, but it is sometimes well to the right of this spot. When the gall-bladder is small it may be very high up and entirely covered by the edge of the right lobe of the liver, whilst sometimes it is considerably enlarged and deflected inwards across the middle line; it has even been met with in the lumbar or cæcal regions. These anomalies in position are due not only to changes in size of the organ itself, but also to alterations in the shape and size of the liver; they are also largely influenced by adhesions of the gall-bladder to neighbouring structures.

As a rule the gall-bladder measures from three to four inches in length and from one-and-a-quarter to one-and-three-quarters of an inch at its broadest part, which is usually about two-thirds of the distance from its neck. Its variations in size are extreme. It may be so large as to be mistaken for an ovarian cyst, whilst on the other hand it may be so small as to escape notice except after the most careful search. A point of practical importance is the marked variation in the thickness of its walls; these may be much thickened as the result of inflammation in the interior; on the other hand they may be as thin as paper, so that any suture introduced through the peritoneal coat must necessarily penetrate into the interior of the gall-bladder.

The gall-bladder lies in contact with the hepatic flexure of the colon, the anterior abdominal wall and, generally, with the first and second parts of the duodenum; it normally contains about an ounce of fluid and should not be felt if it be healthy.

The blood-supply is from the cystic artery, which divides near the neck of the gall-bladder into two main trunks, one of which supplies the free inferior or peritoneal surface, whilst the other runs between the organ and the liver. Although the attachment between the gall-bladder and the liver is fairly loose in the normal condition, any inflammation spreading through the thickness of the walls of the viscus may give rise to very firm adhesions. As a rule there is a partial investment by the peritoneum which passes from the under surface of the liver across the under surface of the gall-bladder; very rarely this may be complete and a definite mesentery may be present.

The mucous membrane about the neck of the gall-bladder and in the cystic duct is thrown into a series of folds, which should be remembered, as they are very embarrassing to a surgeon who attempts to pass a probe from an incision in the fundus down through the cystic into the common duct. The cystic duct measures about one-and-a-half inches in length and passes backwards and slightly downwards and to the left to join the hepatic duct and form with it the common bile duct. These two structures join at an acute angle, and it is important to remember that a lymphatic gland is frequently found in the angle between them, and this may be enlarged as a result of any inflammatory condition about the parts and may simulate a calculus on digital examination. Similar glands are met with over the common duct and may also form pitfalls for the surgeon if they be enlarged. Over the common duct also there are numerous small vessels arranged in an abundant plexus, and these may be a source of troublesome hæmorrhage when the duct is incised.

The common duct is usually divided into three parts, the first being that lying above the duodenum; this is fairly free and accessible and measures about three centimetres in length. The second part lies behind the first part of the duodenum and is more difficult to get at, whilst the third portion is embedded in the pancreas and is practically out of the surgeon's reach from outside. In order to expose the second part of the duct the duodenum and the head of the pancreas must be separated from the front of it. Owing to adhesions it is sometimes difficult to identify the common bile duct after the abdomen has been opened. The simplest way is to trace down the cystic duct from the gall-bladder until it joins the common duct, but with dense adhesions this may be difficult. The best plan then is to forcibly pull up the anterior margin of the liver so as to rotate that organ somewhat upon its transverse axis and to feel for the foramen of Winslow, through which the finger is inserted. The common duct lies in the free edge of the gastro-hepatic omentum, having the portal vein well behind it whilst the hepatic artery lies not quite so far behind and to its left side.

In the portal fissure the order of the structures is duct artery and vein from before backwards.

The function of the gall-bladder is to act as a reservoir for bile and it probably fills up during the night and during fasting and empties itself whilst digestion is progressing. Its complete removal causes no inconvenience and it has been known to be entirely absent.

TRAUMATIC AFFECTIONS OF THE LIVER.

CONTUSIONS AND RUPTURES.—These injuries are not at all uncommon; in fact the liver is the viscus most commonly damaged in all severe blows or run-over injuries about the upper part of the abdomen. The peritoneal coat of the organ gives way and there is extravasation of blood and bile in the abdominal cavity. As we have just said there is a tendency for this extravasated material to collect between the colon and the liver and to be passed down towards the right side and, if the extravasation be small in amount and occur gradually, it may remain limited to that region.

The seriousness of the case varies with the extent of the injury to the liver and more particularly with the injury to large vessels. If the larger branches of the hepatic vein be torn, free hæmorrhage is the result, as the orifices of the vessels remain patent, and in many cases the patient is moribund from the hæmorrhage when first seen. In any case, bleeding is apt to be persistent, probably from the fact that the admixture of bile prevents proper hæmostasis. The amount of bile escaping in an injury of this sort will depend upon whether the large bile ducts are injured or not. The gall-bladder or the bile passages are not infrequently lacerated.

In severe fractures of the ribs the broken ends of the bone occasionally penetrate the liver substance. Penetrating wounds of this kind are not very common, the injuries usually met with varying from a simple fissure on the surface of the organ near the anterior margin to a large stellate contusion, an actual detachment of a portion of the organ or a pulping-up of its substance.

SYMPTOMS.—In bad cases death occurs rapidly from a combination of shock and hæmorrhage. In all patients that survive long enough to come under the notice of the surgeon there is the intense shock met with in bad abdominal contusions (see Part VI., Sec. I., p. 177) and in most cases there will be signs of hæmorrhage in addition. The symptoms special to the injury of the liver are persistent pain over the organ referred also to the umbilicus, the xiphoid cartilage and the right shoulder, and extreme tenderness on palpation over the damaged area; the liver dulness is generally increased, especially on the right side. There may be bilious vomiting and some jaundice later. As a rule the extravasation of a small amount of bile into the peritoneum is not fatal but, should this occur in large quantity, it is a serious matter and fatal peritonitis may result,

probably from contamination of the bile by the colon or typhoid bacillus. Should the bleeding stop spontaneously and the patient recover, absorption of the extravasated material may occur or, on the other hand, a blood cyst may form.

TREATMENT.—This will be influenced largely by the presence or absence of signs of active hæmorrhage.

(a) **Palliative.**—If the bleeding be not marked, palliative measures may suffice. The patient is put on the back in bed with the knees flexed over a pillow to relax the abdominal muscles, and a large ice-bag or Leiter's tubes (see Part I., p. 9) applied over the right hypochondrium. Should there be vomiting it must be checked if possible by suitable drugs¹ as it not only distresses the patient but is an active factor in keeping up the bleeding. For the first two or three days rectal feeding should be practised. A careful watch must be kept for symptoms of severe loss of blood. It is not advisable to inject saline solution unless it be urgently called for by symptoms of severe bleeding, because the hæmorrhage is apt to recur when the blood pressure is raised by the injection and the coagulating power of blood, when largely diluted with salt solution and mixed with bile, is very defective.

These injuries should always be looked upon as extremely serious, and the patient must be carefully watched to see that no sudden hæmorrhage occurs after recovery from the primary shock. Should this happen, the only chance is an immediate laparotomy. A similar procedure is required if the symptoms point to severe hæmorrhage when the case is first seen, and this should be carried out whether there be a wound of the abdominal wall or not.

(b) **Operative.**—It is sometimes said that it is advisable to wait for the patient to recover from the shock before operating for ruptured liver. If, however, the case be accompanied by severe hæmorrhage, the patient will never recover from the shock and therefore, should the surgeon have reason to believe that active hæmorrhage is proceeding, the patient's only chance is immediate operation irrespective of the amount of shock. Every means of dealing with the shock should be employed (see Part I., p. 138), and rapidity of operation is of primary importance especially in the early stages, so that the bleeding area may be reached and controlled as rapidly as possible.

The abdomen should be opened by a free vertical incision immediately to the right of the linea alba. This exposes the central part of the liver and further room may be gained either by lateral incisions carried about a finger's breadth below the right costal margin or transversely outwards to the right through the rectus, just above the umbilicus. There must be no hesitation in making a free incision, so that the surgeon has plenty

¹ Such as acid. hydrocyanic. dil. in three minim doses every three hours, combined with carbonate of bismuth (grs. 20) and bicarbonate of soda (grs. 15); a tumblerful of water taken as hot as it can be borne is also useful.

of room to work through, and this should be done as rapidly as possible. Should it be quite obvious from the injury that the damage extends towards the outer aspect of the right lobe, for instance, the incision may be made at once in the right linea semilunaris and a second one carried from this beneath the costal margin.

The incision should be widely retracted immediately the abdomen is opened and the blood rapidly swabbed away so as to ascertain the direction from which it comes. Directly the bleeding area is found, the oozing is stopped by thrusting sponges or tampons into the gap. This gives time for blood and bile to be cleared out from the peritoneal cavity around, and the surgeon is thus enabled to investigate the exact extent and character of the lesion. It must however be admitted that it is often excessively difficult to arrest the hæmorrhage, even after free exposure of the liver, and the surgeon may see the patient steadily losing blood to an alarming or even fatal degree. This must not however deter him from operating upon these cases, as operation does not increase the hæmorrhage, whereas it gives the patient the only chance of life.

When there is a clean-cut laceration of the liver, attempts to clamp or ligature bleeding vessels on the surface of the organ are futile and moreover the free capillary oozing is sufficient to cause death quite apart from that from the larger vessels, and it is therefore a mere waste of time attempting to clamp or tie them. It is best to trust to pressure, except occasionally when one large vessel is torn and can be secured by under-running it with catgut. The best way of employing pressure is to insert deep mattress sutures through the substance of the liver so as to press the bleeding surfaces together over a fairly large area, in much the same way as for similar injuries in the kidney (see Fig. 28). A large blunt needle on a handle threaded with stout silk or catgut is thrust through the capsule some distance from the edge of the wound on one side, carried deeply through the hepatic substance and brought out at a corresponding point on the opposite side, where the end of the suture is caught by an assistant. The needle is then withdrawn without unthreading it and passed through the liver a second time in a similar manner an inch or so further down the line of laceration. When its point emerges at the opposite side, the needle is unthreaded and withdrawn and the suture is tied. Before doing this the assistant must carefully approximate the torn surfaces and the suture must be tied just tight enough to approximate them firmly without any risk of cutting through the friable liver substance. Other mattress sutures are then introduced in a similar manner if necessary; it is well to put in enough to bring the ruptured surfaces accurately in contact everywhere and the repair of the damage is completed by uniting the capsule throughout by a continuous fine catgut stitch. After this the region is thoroughly flushed out and a drainage tube is inserted at the most dependent angle of the wound to enable all blood and bile to escape, and the rest of the wound is sutured, a loose stitch being inserted where the

drainage tube passes through the soft parts. As a rule it will be advisable to complete the last stages of the operation as rapidly as possible owing to the exhausted condition of the patient, and probably careful suture of the abdominal wall in layers will have to be abandoned in favour of a few mattress sutures taking up the peritoneum and muscles together, the skin being united by a continuous silk stitch.

When there is a large lacerated area with extensions in various directions, the bleeding cannot be controlled in this manner and it will be necessary to have recourse to firm packing of the wound. Attempts may be made to

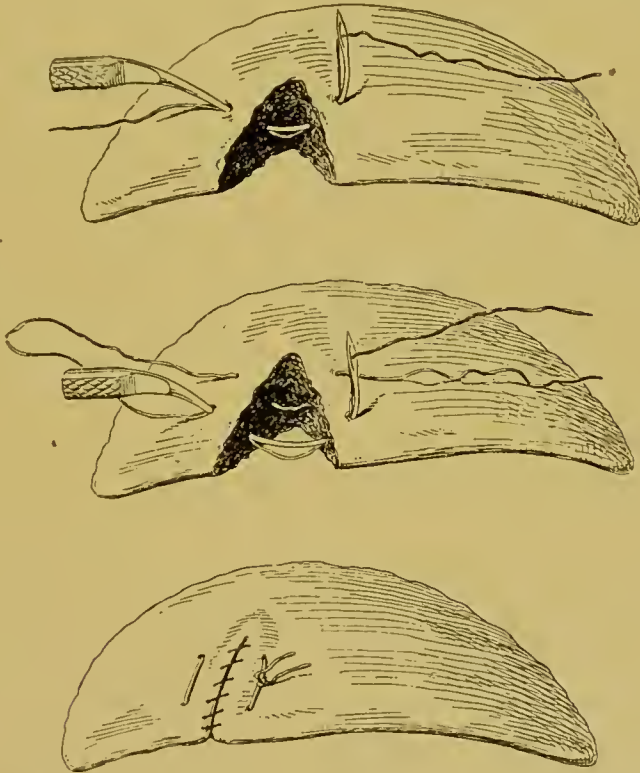


FIG. 28.—METHOD OF SUTURING A LACERATION OF THE ANTERIOR BORDER OF THE LIVER. The two upper sketches show the steps of the introduction of the mattress suture while the lowest one shows this suture tied and the capsule united by a continuous stitch.

under-run and tie any particularly large bleeding vessels, but the remainder of the hæmorrhage must be controlled by packing strips of cyanide gauze as firmly as possible into every recess of the oozing surface. The end of the packing is brought out through the abdominal wall, which is left open for the purpose and, when the bleeding is free, the amount of packing must be large and pressure must be further exerted by a large pad of dressing externally. Packing must of course be rather doubtful in its results as there is no firm point to press against, but under these circumstances it is the only thing that can be done. In free oozing of this kind the deeper portion of the packing in contact with the raw surface may be steeped in adrenalin chloride (1-1000) or a ten-volume per cent. solution of peroxide of hydrogen, so as to get a stronger hæmostatic effect.

Lacerations of the under surface and posterior border of the liver are likely to be very serious, because large vessels in the hilum of the organ are usually torn and the patient commonly dies before aid can be summoned. Should he live long enough for a laparotomy to be done, and should a large vessel be found lacerated, all that is possible as a rule is to clamp the bleeding vessel and leave the forceps on, as the patient will have lost too much blood to justify any attempt at sewing up the rent in the vessel. The wound must be carefully packed as above described; it is not advisable to have recourse to any chemical styptic or to the actual cautery except when a portion of the liver is so far detached as to render re-attachment impossible. Then it will be necessary to remove the affected portion entirely, and a ligature should be applied around the base of the affected portion which is then cut away and the raw surface seared with a cautery at a low red heat.

The best chance for the patient in cases of penetrating wounds of the liver by stabs and gunshot wounds is to disinfect the wound, to open up the abdomen, and to attempt to arrest the hæmorrhage. Small punctured wounds may often have the wound of entrance closed by a circular purse-string suture; in all cases the abdomen must be opened sufficiently freely to enable the wound of exit to be looked for and to receive treatment. The arrest of the hæmorrhage is effected on the lines already described (*vide supra*).

Should the patient recover from the effects of the loss of blood, the prognosis is good. Bile in the abdominal cavity rarely gives rise to peritonitis.

INJURIES TO THE GALL-BLADDER AND BILE DUCTS.

Injuries to the gall-bladder and bile ducts usually occur in connection with injuries of the liver and give rise to very similar symptoms, so that the case is generally diagnosed and treated as one of injury to the liver, and the damage to the gall-bladder or bile ducts is only found at the time of operation. Injuries to these organs may however occur without damage to the liver, and the gall-bladder is more likely to be affected alone than the bile ducts; it may be lacerated as the result of a blow over the gall-bladder region, especially if the viscus be distended. These injuries may also occur as a result of stabs or gunshot wounds.

In nearly all cases the diagnosis will be that of injury to the liver and in most an operation will be undertaken for its cure. Should no operative measures be adopted in the first instance, the extravasation of bile following the rupture will lead to a plastic peritonitis and the formation of a fluctuating swelling, whilst there will also be jaundice due to absorption of bile from the peritoneum. If left alone, the case may end fatally, either from toxæmia due to the absorption of bile, or from septic complications due to contamination of the extravasated material. In some instances, especially if the gall-bladder be healthy and the bile aseptic, the rent in the organ may heal spontaneously and the case will then undergo a natural cure after

absorption of the bile extravasated. If suppuration occurs, the infection may be due either to a septic condition of the bile, as when a diseased and dilated gall-bladder is ruptured, or to organisms that have found their way from the alimentary canal.

TREATMENT.—This should be operative. The abdomen should be opened by the usual incision (see p. 137), the bile sponged away and the condition of the parts examined.

If the lesion be a limited rupture of the gall-bladder the rent may be closed by a double layer of Lembert's sutures, the inner layer taking up all the coats except the mucous membrane, whilst the outer takes in the peritoneal coat only. The region is then flushed out with salt solution and it is well to insert a medium-sized drainage tube down to the region of the laceration for a few days in case infection should have already occurred. Should there be no signs of suppuration, the tube may be removed on the third day and the abdominal wall brought together by a loose suture inserted but not tied at the time of the operation.

Should the rent be extensive, irregular or so situated that suture of it would lead to constriction of the gall-bladder, or should the cystic duct be torn across, the best plan is to remove the gall-bladder entirely (see p. 143).

If a wound be found in the common duct, the treatment will vary according to its nature. If it be a small vertical or slightly oblique slit no attempt need be made to sew it up, as this is a very difficult matter in the normal duct and these lacerations will heal quite well if ample drainage be provided. The question of drainage is fully dealt with in connection with choledochotomy (see p. 147).

Should the duct be torn completely across, an attempt must be made to restore its lumen by suture. Free drainage must be provided in this case also and some surgeons have recommended that a cholecystenterostomy should be performed at the same time, so as to avoid the risk of a permanent biliary fistula should union of the divided ends of the duct fail to take place. There is however an objection to this procedure in that the communication established between the gall-bladder and the intestine at the time of the operation may lead to septic contamination of the bile which will effectually prevent proper union of the divided duct. On the whole it would seem to us better not to perform this operation at the time the duct is sutured but, having united the duct and provided free drainage, to wait for a few weeks in order to see whether union and re-establishment of the common duct will occur. Should this happen, the cure will be complete, while, should union fail and a biliary fistula persist, cholecystenterostomy may be undertaken for its cure as a secondary operation with good prospects of success. This subject is dealt with separately in connection with Biliary fistula (see p. 153).

CHAPTER XIII.

HEPATIC ABSCESS; HYDATID OF THE LIVER: TUMOURS OF THE LIVER.

ABSCESS OF THE LIVER.

THE only inflammatory affection of the liver coming under the notice of the surgeon is hepatic abscess; gall-bladder suppuration is dealt with separately (see Chap. XIV.).

VARIETIES.—Suppuration in the liver may take the form either of small multiple abscesses scattered through the organ or of one, or at most two or three, large circumscribed collections of pus. The small multiple abscesses are practically always associated with pyæmia, either general or portal (suppurative pylephlebitis) and, as surgical measures are of no value for them, we need not discuss them further. The large circumscribed abscesses, however, are of great importance, and may be divided into two groups, viz., those met with in this country and resulting from a variety of causes, and those essentially associated with dysentery—the true tropical abscess.

ETIOLOGY.—Suppuration in the liver sometimes, though rarely, occurs without any apparent cause—the so-called “idiopathic abscess” due to micro-organisms, which probably find entrance along the portal vein. In the great majority of cases, however, a cause may be traced. Liver abscess is not infrequently associated with injuries of the head; here the infective material has apparently spread not in the form of true emboli but by the micro-organisms themselves, which for some reason get caught in the liver more often than elsewhere. Pylephlebitis, which occurs in connection with septic processes affecting the terminals of the portal vein, such as appendicitis or ulcerations of the bowel, may give rise to septic emboli and multiple abscesses. Foreign bodies, such as needles that have found their way into the liver, injuries to the organ or sepsis following injuries to other organs or operations in the portal area, such as those upon the rectum, are well-known causes of the affection; among others may be mentioned parasites in the bile ducts such as worms, echinococci, distoma hæmatobium,

coccidia or actinomyces. Suppuration in the liver may also arise in connection with gall-stones, the affection here, however, being primarily gall-bladder or bile duct suppuration; this is dealt with separately (see Chap. XIV.). The abscesses are due either to the ordinary pyogenic organisms or to the colon bacillus.

Abscesses due to the above causes may also occur in tropical countries, but in addition there is a particular form known as "tropical abscess of the liver," which is of great importance. This affection begins to be met with about the 48th degree of north latitude, and increases in frequency further south; it occurs sporadically, however, somewhat further north than this. In this geographical area acute and sub-acute hepatitis are common, and the inflammation of the liver may end in tropical abscess. The disease is essentially associated with true tropical dysentery, although it may come on a considerable time after the attack has passed off, and may even be found after all ulceration has completely healed. It is now held by many that true tropical dysentery is due to an amœba, and this parasite has been found in large numbers in the wall of tropical abscesses, if not actually in the pus. In addition, the ordinary pyogenic and other kinds of organisms may be present, and the question of the etiology of these abscesses is, therefore, very complicated. The course of the affection is also modified according to the nature of the other organisms which find entrance simultaneously with, or subsequently to, the amœba. Those who hold the amœba theory consider that in all probability the amœba alone produces a very slow breaking down of the liver without acute suppuration—the typical tropical abscess; whereas those cases marked by very acute inflammatory symptoms are due to a mixed infection, and the acuteness of the attack is, to a certain extent, proportionate to the severity of the infection by other organisms.

Malaria is said by many to play an important part in the causation of the affection, but the abscess is not due to the malaria parasite. By its general effect upon the system and by its local effect upon the liver, malaria may pave the way for the true parasitic invasion which causes tropical abscess.

PATHOLOGICAL ANATOMY.—The great majority of tropical abscesses are single. In some cases, however, there may be two, three, or even five abscesses in the liver; when a larger number than this is present the case is probably of an embolic nature. In something like two-thirds of the cases the abscess is situated in the right lobe. As a rule it varies in size when it comes under surgical observation from an apple to a child's head; the average size is that of a fairly large orange. The abscess is usually spherical and contains ordinary pus, generally tinged with an admixture of blood and bile. Thus it may be yellow, greenish-orange, blood-red, or brown in colour, and it often contains discoloured clots and portions of broken-down liver substance. In the acuter forms the abscess wall is pulpy and contains broken-down hepatic tissue; in the more chronic ones there is a kind of thickened abscess wall. In

bad infective cases the wall of the abscess may be actually gangrenous, and here recovery is rare, even after free drainage.

Except in cases of embolic origin, the abscess usually commences deep in the substance of the liver and tends to spread to the surface. When of any size it generally projects from the convex surface of the right lobe, but may spread backwards to the area of the liver uncovered by peritoneum and may also extend downwards towards the peritoneal cavity, especially in the neighbourhood of the stomach. When the pus reaches the surface, various complications may occur according to its situation. When it reaches the convex surface of the liver, as it most commonly does, that organ and the diaphragm become adherent, and the pus finds its way through the latter, causing the under surface of the lung to become adherent to the upper surface of the diaphragm, so that the pus may make its way into the lung and be evacuated through the bronchi. Occasionally the lung does not become adherent, and the abscess bursts into the pleural cavity and an empyema occurs. When the pus finds its way to the surface of the liver uncovered by peritoneum, the abscess tends to spread into the abdominal wall. When it points at the lower and front part of the liver, the stomach (in abscess of the left lobe), duodenum or colon may become adherent to it and the pus may discharge into the alimentary canal.

SYMPTOMS.—In many cases hepatic abscess occurs in connection with some well-recognised disease, such as dysentery, and its presence may be obscured by this disease and may remain unsuspected for a long time. On the other hand, the liver affection may begin suddenly and be easily recognised on account of the acuteness of the symptoms. The typical symptoms are fever, pain in the right side, associated with chilliness or a rigor, and bulging of the parietes accompanied by progressive loss of weight. In some cases of tropical abscess, however, there may not be sufficient symptoms in the early stages to lead to a correct diagnosis, and cases have occurred in which the abscess has only been found *post mortem*, although it must have existed for a long time.

There are one or two points, however, which, quite apart from the acute inflammatory symptoms, point to the occurrence of a liver abscess. There is a peculiar yellowish, earthy colouration of the conjunctivæ and also of the skin without true jaundice. The position of the patient is often symptomatic; the tendency is to bend towards the right side, to draw up the right thigh and to firmly and permanently contract the right rectus and other muscles on the right side of the abdomen. Some authors assert that this position is typical of an abscess situated on the concavity of the liver, whereas when it is on the convexity the tendency is said to be to bend towards the left. Alterations in the shape of the liver are also observed. The organ is in any case somewhat larger than normal, and occasionally distinct irregularity in outline may be made out by percussion or palpation. When there is a large abscess on the con-

vexity of the organ there may be a diffuse bulging in the lower intercostal spaces and peritoneal crepitations may be heard over it. In smaller abscesses a lesser degree of bulging is best detected by standing behind the patient lying perfectly straight upon a flat couch or a table. Tenderness on pressure may be made out, but fluctuation is seldom elicited unless the abscess has become subcutaneous or penetrates the thoracic cavity, when fluctuation may occasionally be detected in one of the intercostal spaces. The heart is generally displaced upwards and to the left. Some fever is almost always present in the early stages, but it may be absent in the chronic cases; in the very acute form it is high from the commencement. In the chronic cases it is often irregular, and not very high, while in malarial subjects it is of a more malarial type; rigors may also be present. When the suppuration is in the left lobe or in the smaller lobes on the concavity obstinate vomiting is frequently noticed.

From a practical point of view the chief point of importance after the diagnosis of an abscess is its situation. The following points may be mentioned. When the abscess is on the convexity there are symptoms affecting the thoracic organs, such as increased dulness upwards, difficulty or pain on respiration, pain in the right shoulder, projection of the lower ribs and possibly fluctuation. When the abscess is situated in the centre of the organ, there are, in addition to the ordinary inflammatory symptoms, only moderate swelling of the organ and a little jaundice if the abscess be very large. In abscesses situated on the under surface of the liver there is marked projection of the organ downwards into the abdominal cavity, vomiting, pain in the right flank and hip rather than in the shoulder and frequently jaundice from pressure on the bile ducts.

TREATMENT.—The usual surgical rule of evacuating the pus as soon as its presence is determined must be followed, and the question to be considered is how this shall be done.

In the comparatively rare cases in which the pus finds its way into the abdominal wall it is clear that the swelling there should be incised, the track traced up to its point of emergence from the liver and sufficiently enlarged for efficient drainage. The difficult cases however are those in which the pus is still confined to the liver or has spread thence into the lung or the pleural cavity; the great difficulty here is the protection of the serous cavity. In a very large number of cases in which the abscess follows its usual course towards the convex surface, adhesions will have formed before the surgeon sees the case, but in others there will be none, and this may be the case also when the abscess is situated on the under surface, although surrounding structures, such as the omentum or the bowel, may be adherent to its surface; the condition is closely analogous to the deep-seated forms of appendicitic abscess (see Part VI., Sec. I., p. 376), with the exception however that the pus in an hepatic abscess is usually not so virulent as it is in one from the appendix.

Aspiration.—This was formerly a favourite method of treatment, the pus being drawn off at one or more sittings through as fine a needle as it could be made to flow through. This method has occasionally cured chronic cases, but in our opinion more efficient methods are available at the present day, and we shall not therefore refer further to it. An advance on this plan was the introduction of a large trochar and cannula into the abscess cavity, the cannula being left as a permanent drain. As a rule however the cannulæ are much too small.

Incision and drainage.—The only method that offers a prospect of a really good result is free incision, and the technique of the operation varies with the presence or absence of adhesions and the situation of the abscess. Some surgeons lay great stress upon this question of adhesions, and when none are present they proceed to shut off the peritoneal cavity by sutures in a methodical manner. Others on the other hand open the abscess freely even in the entire absence of adhesion between the liver and the abdominal wall at the point of incision. In our opinion much depends on the situation in which the abscess has to be opened. If this has to be done through the anterior abdominal wall, the greatest care must be taken to prevent extravasation of pus into the abdominal cavity, just as in the case of an appendicitic abscess. If however the abscess be situated on the convex surface of the liver and the opening be made through the diaphragm, experience shows that the majority of cases do perfectly well if a drainage tube be introduced directly into the cavity without any preliminary suture of the liver to the diaphragm.

Before proceeding to operation it is always well to ascertain that pus exists by puncturing the liver with a trochar and cannula. The spot selected for puncture will depend upon circumstances. When there is distinct bulging below the ribs on the right side and there is reason to believe that the abscess is situated towards the under surface, the puncture should be made below the ribs behind; but in the majority of cases it should be made through an intercostal space, as the abscess will be on the convex surface. The usual rule given is that the needle should first be thrust inwards and backwards through the seventh or eighth intercostal space in the anterior axillary line and the liver explored in various directions from this spot. If no pus be found, the needle may next be introduced just below the ribs in the nipple line and, failing to find pus there, it may be thrust through the ninth or tenth interspace, immediately below the inferior angle of the scapula; this avoids puncturing the pleura. It is always well to have an exhausting syringe or an aspirator bottle that will fit the cannula and, as soon as the tip of the latter reaches the liver, the air should be drawn from the cannula so that pus will flow out directly it is struck; otherwise the cannula may actually pass through the abscess cavity without drawing off the pus. This procedure is also valuable for avoiding infection of the wound or the peritoneal cavity by the pus in the cannula as it is withdrawn.

If pus be not struck when the cannula is first thrust in, the latter should

be withdrawn until its point is near the surface of the liver, when its direction is altered and it is plunged in once more. If a cannula or needle of fairly large bore be used, there is usually a free flow of blood whether pus be struck or not; and this is useful as showing the patency of the instrument; if nothing comes through, it is probable that the cannula has become blocked with liver substance and it is well to force a few drops of boracic lotion through the needle without withdrawing it so as to clear it. In performing an exploratory puncture care must be taken to allow the needle to move freely with the liver in respiration as otherwise the liver substance may be unnecessarily torn. This mobility of the exploring needle is sometimes an important point, as the absence of it indicates the presence of adhesions to the diaphragm. When these occur, the right side of the diaphragm is usually more or less paralysed and the liver, and consequently the needle, are stationary.

When pus has been found, the object of the puncture is attained and no attempt should be made to draw off any large quantity. The question now arises as to whether the needle should be withdrawn or whether the abscess should be cut down upon with it *in situ* as a guide. When the puncture has been made through an intercostal space, it is better to leave the needle in position but, if the puncture has been made through the abdominal wall, this is not necessary as the laparotomy will expose the surface of the liver and the point of puncture is easily seen, whereas the needle left in position might easily damage the liver substance as the abdomen is opened.

The incision and drainage of the abscess should be done at one sitting. It was formerly the practice to establish adhesions at a first operation either by stitches inserted between the liver and the abdominal wall or by gauze packed into the wound, and a few days later a second operation was done for drainage of the abscess after the adhesions were established. There is at the present time a certain amount of dispute as to the necessity for preliminary stitching of the liver to the abdominal wall before the former is incised, but all surgeons are agreed that the operation should be done in one stage. Whilst we admit that any attempt to stitch the liver to the abdominal wall is necessarily imperfect owing to the friability of the liver, we think that, wherever possible, means should be taken to shut off the peritoneal cavity from infection, and these means have already been dealt with in speaking of appendicitic abscess (see Part VI., Sec. I., p. 395). By packing gauze around the drainage tube for 24 to 48 hours one can practically always reckon upon avoiding infection of the peritoneal cavity even by the most virulent pus.

When the abscess has to be opened from the abdomen, a free oblique incision should be made just below the costal margin or directly over any prominence that may be present. When the liver is exposed it is first palpated, when in all probability the abscess will be made out; if not, a large aspirating needle should be introduced and the pus again sought for. Before doing this however gauze or abdominal cloths should be packed in

between the abdominal wall and the surface of the liver, leaving a sufficient area of the latter exposed for free manipulations, just as in evacuating pus through the abdominal cavity. It is well to empty the abscess as thoroughly as possible with the aspirator before proceeding further because a large abscess may push the liver out of position, so that, when the pus has escaped, the same part of the liver is no longer opposite the abdominal opening and therefore a tube introduced before the abscess is evacuated, it will be liable to become kinked and to allow pus to escape beside it. If however the contents of the abscess be first removed by an aspirator, the liver assumes the position in which it will remain after the operation and the opening into the abscess cavity may then be made with the certainty that the relation of parts will not subsequently become disturbed.

After the pus has thus been removed, the needle is retained in position, the packing is re-arranged so as to insure the abdominal cavity being thoroughly shut off, and the liver is bored through with a blunt instrument until the abscess cavity is reached; the track is then enlarged sufficiently to admit a No. 24 drainage tube. The incision in the liver should be just large enough to grasp the tube, so that pus is not likely to escape alongside it, and the tube should only have holes just at the end where it lies in the abscess cavity. The tube is now packed around with gauze, and the greater part of the abdominal wound is left open, only the ends of the incision being brought together with silkworm gut. Some surgeons lay considerable stress on washing out the abscess at the time of the operation. This we have always avoided, but, if there be much *débris* present, it might be well to do so; but on the whole, if this has to be done, it is perhaps better to wait for 24 or 48 hours until the peritoneal cavity is completely shut off, as otherwise there must be some risk of fluid escaping into it. In our opinion daily irrigations of the abscess cavity are to be condemned here just as in other acute abscesses. When there is only a single abscess and it is treated in this manner it does perfectly well in the majority of cases; the cavity closes in a month or six weeks and the patient is restored to health.

The place of election however to open the liver abscess is through the thoracic wall. The pus is found by the aspirator (see p. 116), when the flow through the needle is stopped and the latter left in place in the position already recommended, *e.g.* the ninth or tenth interspace vertically below the lower angle of the scapula. A free incision is now made over the rib below the needle, the rib is excised, and the dissection is carried down either until the pleural cavity is opened or until the diaphragm is reached. In some cases the incision will be below the pleura; in others, inflammation may have obliterated it. Should the pleura be opened, the parietal layer should be detached from the thoracic wall, whilst the layer covering the diaphragm is also dissected up and the two cut surfaces are closely united by a continuous suture so as to shut off the pleural cavity. A little gauze may be packed over it for additional protection.

The diaphragm is now incised with a narrow-bladed knife which is slipped in along the needle. Whilst this is being done the assistant should press the liver firmly up against the diaphragm so as to approximate the two structures and prevent the escape of pus between them. After the diaphragm and capsule of the liver have been incised in this way, a long pair of dressing forceps is thrust along the needle until it reaches the abscess cavity, when the blades are expanded sufficiently to admit a drainage tube (*vide supra*).

When the pleura has been opened it is well to pack the wound around the tube with gauze for 24 hours; when however it has not been opened this is unnecessary. The bleeding, although often free, practically stops as soon as the drainage tube is inserted, the pressure of the latter bringing about the arrest of hæmorrhage. The cases usually do quite well.

HYDATID OF THE LIVER.

The liver is a very common seat of hydatid cysts, nearly half of all cases of echinococcus occurring in this viscus. This is explained no doubt by the fact that the embryos may be present in large numbers in the intestine and, finding their way through the alimentary canal, get into the portal vein and are carried thence to the liver. They occur far more frequently in the right than in the left lobe; this is probably due to the arrangement of the portal vein.

The cyst is usually single and may attain a very large size. There may however be many cysts scattered all through the liver, varying in size from a small pea to a large orange, or many cysts may be aggregated together and form a large lobulated mass. The cyst is surrounded by a capsule of connective tissue which forms a dense wall and is developed from the organ or tissue in which the cyst lies. Internal to this connective tissue capsule lies the true cyst wall, which is a laminated chitinous structure without any cellular or fibrous elements and which is apparently penetrated by the juices of the body by which the parasite is nourished. On the inner surface of the true cyst wall is a delicate parenchymatous layer in which are developed the young heads or scolices, which may number many thousands and may remain for a long time or even permanently connected with this membrane or may become detached, so that there is a large cyst full of numerous smaller or "daughter" cysts; it is probable that these heads die when they are detached. Besides the solid contents there is a large amount of fluid in the cyst, mainly consisting of water containing some 2%-3% of solid material, half of which consists of chloride of sodium. There is no albumen, but succinate of soda seems to be a constant element in hydatid of the liver and a substance resembling sugar may also be present; this does not occur in echinococcus cysts elsewhere, so that it may have a certain diagnostic value.

As the parasite grows it causes enlargement of the liver, while at the same time it destroys that portion of the organ in which it lies and may ultimately perforate some other structure, into which the cyst may burst. The larger vessels and the bile ducts are only rarely affected by the pressure, but cases occur in which ascites and jaundice are seen. An hydatid cyst may burst into the pleura, the intestine, the peritoneal cavity or, more rarely, into the pelvis of the kidney or the gall-bladder. Occasionally it dies and shrivels up, becomes calcified or remains stationary. On the other hand, suppuration and hepatic abscess may occur.

SYMPTOMS.—Occasionally there are slight constitutional symptoms, such as attacks of urticaria, probably from escape of some of the fluid either into a vessel or into the peritoneal cavity. The liver becomes enlarged as the tumour grows, and may be tender and deranged in function. The enlargement may be uniform or irregular according as the cyst is situated deep in the substance of the liver or towards one margin. When it projects from the upper surface, an irregular line of dulness may be obtained on percussion. In other cases a distinct tumour may be felt in the abdomen, and then fluctuation can often be made out. Symptoms of pressure on the stomach, intestines or lung may also be met with according to the situation and size of the tumour.

Should the cyst burst into the pleural cavity, there is a sudden violent pain in the side with great dyspnœa, followed by acute pleurisy, often rapidly fatal. Should the cyst be suppurating when it ruptures, there will be an empyema instead of a simple pleurisy. When the cyst bursts into the peritoneum, there is intense and prolonged collapse, and rapid death sometimes occurs. If not, violent peritonitis develops and there is usually urticaria also. The fluid from the cyst evidently contains some poisonous material, and not merely the innocuous ingredients that the chemical analysis would seem to imply, and this fact is an important contra-indication to treating a case by simple puncture because, quite apart from the possibility of infection by the hooklets or by suppuration, the constant leakage of hydatid fluid into the abdomen may give rise to serious symptoms.

A few words are necessary as to the diagnosis of hydatid of the liver, which is often very difficult, at any rate in the early stages. A slow-growing irregular enlargement of the liver, which is smooth in outline and fluctuates freely, is practically certain to be of this nature. From hydrops of the gall-bladder it may be distinguished by a recognition of the characters of an enlarged gall-bladder (see p. 132). From pleural effusion it may be distinguished by the length of the history, the insidious onset and the alteration in the level of the dulness during deep inspiration; in hydatid this descends during inspiration whilst it remains unchanged in pleural effusion. It is not easy to distinguish an hydatid of the liver from a tuberculous empyema until after a puncture has been made and some of the fluid has been withdrawn.

TREATMENT.—Of the methods employed for hydatids of the liver we shall describe simple puncture, puncture followed by the injection of sublimate solution, enucleation of the cyst and excision.

Simple puncture.—Although simple puncture with the withdrawal of a portion of the contents sometimes brings about the death of the parasite, it is attended by so much danger and uncertainty as to render its use practically unjustifiable. However small the puncture may be, leakage of hydatid fluid is almost certain to occur and to cause serious symptoms; moreover the parasites may escape and form secondary cysts on the peritoneum. Hence puncture should only be employed as a diagnostic measure and then only when the surgeon is prepared to proceed immediately to operate. It should not be employed when there is suppuration in the cyst.

Puncture and injection.—Some surgeons advocate the injection of sublimate solution (1-1000) in addition to puncture. About a third of the contents of the cyst is withdrawn and then a quarter of this amount of sublimate solution is injected and left in. The solution brings about the death of the parasites and shrinkage of the cyst. The method is worth a trial when there are multiple cysts which cannot all be cleared out. The smaller ones may be tapped and injected in this manner. As a routine method of treatment however we cannot advocate it.

Enucleation.—In our opinion the best method of treatment is to lay open the cyst and clear out the daughter cysts, either by laparotomy or through the thoracic wall when the cyst bulges up in the sub-phrenic region. When the operation is done through the abdominal cavity, a free incision is made over the most prominent part of the swelling so as to expose the cyst wall thoroughly. In the earlier days of abdominal surgery the liver substance around the cyst wall was then sutured to the parietal peritoneum and the wound left open for a few days until adhesions had occurred, when the cyst was incised and its contents evacuated. More recently however many surgeons complete the operation at one sitting and this is undoubtedly the better plan if it can be done. The whole area around the exposed cyst wall is packed with gauze, just as before opening an intra-abdominal abscess, and when the peritoneal cavity has thus been safeguarded, a large trochar and cannula is thrust into the cyst and as much of the fluid contents as possible evacuated through it; should the cannula get blocked by the protrusion of daughter cysts into it, a small quantity of boracic lotion syringed in will displace them and allow the fluid to flow. As the contents are withdrawn the cyst wall becomes flaccid and can often be drawn well up out of the wound by suitable strong catch forceps. Fresh packing is now substituted and the wall of the cyst is drawn as far out of the abdomen as possible, the patient if necessary being turned slightly over on one side, and then a free incision is made through the cyst wall and the more solid contents are evacuated, their escape being assisted by irrigation. If possible the outer true cyst wall should be enucleated from the fibrous envelope surrounding it; this is usually comparatively easy, as the connection between the liver and the true cyst is

somewhat loose and the finger or a blunt dissector can separate the two. This leaves a cavity in the cellular tissue which closes very quickly.

When the contents of the cyst have been evacuated, a sponge is thrust into the cavity, the gauze packing around is removed and the parts are thoroughly douched with salt solution. The opening in the cyst is now carefully united by a continuous catgut suture to the cut edges of the peritoneum, the sponge is withdrawn, large drainage tubes are introduced into the cavity and an antiseptic dressing is applied. If the true cyst wall has been removed, the cavity closes quickly and no subsequent irrigation of the wound is required, the drainage tubes being shortened as the cavity contracts. If however a portion of the wall or some of the daughter cysts have been left behind, the cavity must be flushed out from time to time with sterilised salt solution in order to get rid of these substances which would otherwise prevent healing.

If other cysts be present in the immediate neighbourhood of the primary one they may be drained through the original opening by burrowing through the liver substance until they are reached. Should the cyst be multilocular, all the septa must be broken down; should it be suppurating, a similar procedure must be adopted, but extra care must be taken to prevent infection of the abdominal cavity and, in fact, the case must be looked upon as one of abdominal abscess. As a rule, however, adhesions have already formed between the cyst and the abdominal wall in these cases, and the treatment is comparatively simple. It is quite unnecessary to pack the cyst after incision.

Excision.—Complete removal of the cyst with its investing capsule is a procedure that is seldom feasible, and is quite unnecessary if the true hydatid cyst wall be peeled off. An attempt to remove the fibrous capsule from the liver substance means an extensive operation, accompanied by bleeding which it is difficult to arrest, and accompanied also by the escape of bile. Occasionally, however, the cyst is almost pedunculated and projects from the surface of the liver, so that only a small portion of its circumference is in contact with hepatic substance, and then it may be possible to separate the two structures with a blunt dissector, arresting the oozing by passing sutures deeply through the liver substance as for cases of rupture (see Chap. XII.). Oozing will go on from the raw surface for some time afterwards, and it is well therefore to introduce a drainage tube.

When the hydatid cyst grows from the upper and posterior surface of the liver it may project in the sub-phrenic region and cannot be reached by a laparotomy. The latter method, however, is the best wherever it can be carried out and, even if it should involve the removal of the ends of two or three of the floating ribs, it should be attempted if it appears probable that the cyst can be reached thus through the abdomen. When it is necessary to reach it by the thoracic route, the best plan is to remove a portion of the eighth or ninth ribs in the anterior axillary line, to suture the parietal to the diaphragmatic pleura and then to incise the diaphragm much as for an hepatic abscess (see p. 119). If adhesions have formed

between the cyst and the under surface of the diaphragm there will be no further difficulty and the cyst can be laid open freely, its contents evacuated, and large drainage tubes inserted. If, however, adhesions are absent, the steps of the operation will be identical with those for the treatment of the cyst through a laparotomy wound, the edges of the cyst wall being pulled up through the opening in the diaphragm and attached to the deeper part of the wound.

When an hydatid of the liver has burst into the abdominal cavity, the proper treatment is immediate laparotomy and thorough flushing of the abdominal cavity in the usual manner (see Part VI., Sec. I., p. 210), followed by removal of the cyst wall and drainage of the cavity left.

TUMOURS OF THE LIVER.

The majority of hepatic tumours are carcinomata secondary to similar disease elsewhere, and therefore not amenable to surgical treatment. Certain simple tumours of the liver, such as adenoma and angioma, and also primary malignant growths, particularly those of the gall-bladder and its neighbourhood, may however be removed, and Keen¹ has collected 76 cases of partial resection of the liver, with a mortality of 14.9%.

Little need be said as to the diagnosis and symptoms of the affection. In the majority of cases the diagnosis is made during an exploratory laparotomy to ascertain the nature of a localised enlargement. Should the physical characters point to an isolated solid tumour in the liver, it is always advisable to perform an exploratory laparotomy to ascertain the exact condition of affairs and to excise the growth if possible. Operation is contra-indicated if jaundice be present.

TREATMENT.—It may be possible to excise small tumours situated for instance on the anterior margin of the liver with a knife, and to control the hæmorrhage afterwards by bringing the cut surfaces accurately together by deep sutures, as already described for laceration of the organ (see p. 108). As a rule however the anatomical conditions negative this, and more elaborate means must be taken to control the hæmorrhage, which is the serious part of the operation. Mayo Robson describes the following method: The portion of the liver to be excised is brought out through the wound, the margins of the parietal peritoneum are then sutured to the capsule of the liver all around the base of the tumour and long pins are thrust through the organ at right angles to each other; behind these an elastic ligature is tied tightly around the base of the tumour so as to control the circulation. The pins serve both to keep the liver projecting well from the abdominal wound, and also to prevent the elastic tourniquet from slipping forward. The projecting portion of the liver containing the growth is then seared through by a Paquelin cautery at a dull red heat. When this has been done, the elastic ligature is gradually loosened

¹ *Annals of Surgery*, 1899, p. 267.

without withdrawing the pins, in order to see whether the hæmorrhage has been effectually controlled. Any bleeding spot can be dealt with readily by a fresh application of the cautery, and when this has been satisfactorily done the ligature is removed; the pins however are allowed to remain for a few days, partly to keep the liver well up in the wound, and partly also to enable the ligature to be reapplied should hæmorrhage recur. If the cautery be insufficient to check the hæmorrhage, the elastic ligature may be reapplied and kept on, large antiseptic dressings being applied outside, the pins and ligature, with the constricted portion beyond, being allowed to separate by ulceration. Healing then occurs by granulation in the ordinary way, and may, if necessary, be hastened by the application of Thiersch's grafts.

In one case Keen removed a carcinomatous left lobe of the liver entirely with a Paquelin cautery, the only trouble met with being during the division of the large veins. He arrested the bleeding temporarily by digital pressure, and finally under-ran the main bleeding points and secured them satisfactorily. The wound was packed with iodoformed gauze, which was removed in the course of two or three days.

CHAPTER XIV.

THE INFLAMMATORY AFFECTIONS OF THE GALL-BLADDER AND BILE DUCTS.

THESE may be divided into the inflammatory affections of the gall-bladder—cholecystitis—and those of the bile ducts—cholangitis. The affections are generally acute, and may be simple or suppurative.

CHOLECYSTITIS.

SUPPURATIVE CHOLECYSTITIS.—This generally takes the form of simple empyema of the gall-bladder and is usually associated with the presence of stones in the gall-bladder. There may be however a gangrenous inflammation or a perforation of the organ; the gangrenous form, which is very rare, not infrequently accompanies typhoid fever, dysentery, or appendicitis.

Empyema of the gall-bladder is generally associated with a stone lodged in the neck of the organ or the cystic duct, the gall-bladder dilating behind it. There need be little or no constitutional disturbance, unless ulceration of the mucous membrane be present, and the patient merely suffers from anorexia and malaise, with a little pain referred to the right hepatic region, and some tenderness on palpation over it. When there is a distended gall-bladder, this can be felt as a rounded swelling just outside the ninth right costal cartilage. When however there is no distension, the true state of matters is often not found out until the abdomen has been opened.

When the suppurative inflammation has lasted for some time, firm adhesions occur around the gall-bladder which may become fixed to the abdominal wall, while at the same time there is an increase in the general symptoms, with marked pyrexia and great tenderness on pressure, immobility of that part of the abdomen and, in fact, symptoms of localised peritonitis. When the pus finds its way out from the gall-bladder it generally does so

through the abdominal wall, either below the costal margin or more commonly in the neighbourhood of the umbilicus. As a rule the adhesions prevent perforation into the general peritoneal cavity; occasionally the abscess may perforate the bowel or may find its way into the sub-phrenic region.

Hepatic abscess may result from very acute cholecystitis. The pus then probably makes its way through the wall of the gall-bladder between it and the liver, and the liver abscess starts from this spot. This condition has already been dealt with (see Chap. XIII.).

Perforation of the gall-bladder may also follow acute suppurative cholecystitis, generally when there are gall-stones present. The symptoms are much the same as in the preceding condition, and are mainly those of localised peritonitis, followed suddenly by symptoms of perforation and acute general peritonitis.

Acute gangrenous cholecystitis is a very rare form, and is seldom diagnosed before operation. It may complicate gall-stones, but it more commonly follows specific fevers. The symptoms are very severe; the entire thickness of the gall-bladder is affected, its walls become gangrenous, and there is intense peritonitis. The proximity of the bowel to the gall-bladder accounts for the fact that some intestinal obstruction usually occurs in these cases; in fact, they are usually mistaken either for acute obstruction or perforative peritonitis.

Treatment.—The treatment of suppurative cholecystitis is operative, but the exact condition of affairs is generally not diagnosed before operation, which is probably undertaken on the assumption that gall-stones are present.

The treatment for empyema of the gall-bladder will be dealt with in connection with gall-stones (see Chap. XV.). The treatment of abscess of the liver has already been described (see p. 115). If the diagnosis be made, the treatment of perforation of the gall-bladder or acute gangrenous cholecystitis will be immediate laparotomy in the right hypochondriac region, followed by the evacuation of any extravasated bile, the removal of the remains of the gall-bladder if possible, and if not, free incision of it, followed in either case by efficient drainage. These operations are dealt with elsewhere (see Chap. XV.).

NON-SUPPURATIVE CHOLECYSTITIS.—This usually occurs as a chronic catarrh of the gall-bladder, and may give rise to symptoms closely simulating those of gall-stones. The gall-bladder contains thick mucus which, in its passage along the cystic duct, gives rise to attacks of colic, often of considerable severity, and it is probable that this condition generally precedes the formation of true gall-stones. As a rule the condition is only diagnosed after operation, which is undertaken on the assumption that gall-stones are present. Jaundice is very rarely met with.

Treatment.—Should the condition be diagnosed before operative interference is undertaken, the treatment should be directed to carefully regulating the diet, prescribing proper exercise, and promoting peristaltic action by the

administration of suitable laxatives. Occasionally small doses of morphine may be necessary for the attacks of colic.

Should the affection persist in spite of these means and cause the patient much trouble, the suspicion that gall-stones are present becomes so strong (especially if the patient has at some time passed gall-stones) that the abdomen is opened. Even should no stones be found under these circumstances, operation is still the best method of treatment, as drainage of the gall-bladder (cholecystostomy) for a few weeks will generally cure the condition, the mucous membrane returning to its normal condition. The operation of cholecystostomy is fully dealt with elsewhere (see Chap. XV.).

CHOLANGITIS.

This affection is usually divided into the suppurative and the non-suppurative forms. About the latter we shall say nothing as it is simply the ordinary catarrhal jaundice which is strictly a medical affection. Catarrhal jaundice may also arise from simple catarrhal cholecystitis which spreads from the gall-bladder down the cystic and thus into the common duct.

SUPPURATIVE CHOLANGITIS.—This affection is generally divided into two main groups. In the first, the suppuration affects the main ducts and is termed "*suppurative cholangitis*," whilst in the other the primary branches of the bile ducts are affected and the disease is termed "*diffuse cholangitis*." Both affections are bacterial in origin and the most frequent factor in their production is undoubtedly the presence of gall-stones. Occasionally foreign bodies, such as an intestinal worm or an hydatid in the bile passages may set up the affection, whilst it also occurs in connection with typhoid fever, appendicitis, pyæmia, or dysentery. When any of the latter group of causes is at work the affection is very apt to assume the diffuse form, whilst, when the mischief is set up by a foreign body, suppuration in the common bile duct is more common.

Suppurative cholangitis is usually due to the presence of gall-stones in the common duct, the organisms finding their way up along this structure from the bowel. The symptoms are very similar to those of the diffuse form but are not so severe. There is high fever with deep and persistent jaundice, which however may vary considerably in degree from time to time. The liver is not enlarged and the gall-bladder is not distended. The patient may remain in this condition for a considerable time, the discharges from the duct finding their way alongside the stone into the duodenum and exacerbations may occur as the blockage becomes complete. On the other hand, the inflammation may pass on to acute suppurative hepatitis, the symptoms of which have already been dealt with (see p. 114).

Diffuse cholangitis.—This is more common in connection with specific diseases, such as typhoid fever, appendicitis, pyæmia, or dysentery.

The inflammation varies much in intensity and may be suppurative, phlegmonous or gangrenous and may be followed by most serious complications, such as septicæmia or pyæmia. The symptoms are similar to those of the simple suppurative form, but rigors are generally present, the liver is markedly enlarged, and the patient rapidly falls into the typhoid state.

Treatment.—The treatment of this affection should be mainly directed to the cause and will consist in removing any gall-stones that have given rise to the affection and securing efficient drainage of the bile passages (see Chap. XV.). Any abscess in the liver should also be opened and drained as early as possible (see p. 115). Should no gall-stones be found either in the gall-bladder or in the common duct, the case is presumably one in which the inflammation has spread from the gall-bladder, and a cholecystostomy with drainage for a few weeks should be employed. In all cases the common duct should be incised if possible and efficient drainage provided. These operations are dealt with elsewhere (see pp. 140, 145).

CHAPTER XV.

GALL-STONES: BILIARY FISTULA.

GALL-STONES.

CALCULI in the gall-bladder or the bile ducts are rare in young subjects, but are very common after middle age; they are more frequently met with in women than in men, and it is said that they occur about once in every six subjects over sixty years of age. In a large number of cases the presence of stones gives rise to no symptoms, and the affection is only discovered *post mortem*. The size and number of the stones vary widely; single stones are usually large, whilst multiple ones are smaller and have facets on their surfaces where they are pressed against one another.

The composition of the stones varies slightly, but consists mainly of cholesterin, with a varying amount of bile salts and bile pigment, principally bilirubin; with these also occur lime salts, and the consistency of the stone may vary from an extremely friable mass to one that it is difficult to break by pressure between the fingers.

CAUSATION.—The affection is predisposed to by anything that hinders the flow of bile, and in this connection some authors have attached importance to the wearing of stays and costal respiration, together with the accompanying weakness of the abdominal muscles that they entail. A sedentary life and irregular meals may be of importance, as the gall-bladder in these cases is not emptied frequently and regularly. Heredity seems to have some distinct influence. The essential factor is the retardation of the bile flow and, when this occurs, organisms—such as the colon or typhoid bacillus—probably find their way into the gall-bladder and set up a cholecystitis of varying intensity. This gives rise to the deposit of cholesterin, which, with precipitated bile pigment, forms the gall-stone. The actual nucleus is often a mass of inspissated mucus, epithelium, or bile salts. Organisms, dead and alive, have been found in a large proportion of stones that have been examined for their presence. Gall-stones are nearly always formed in the gall-bladder, but they are occasionally formed in the bile ducts themselves.

COURSE.—Gall-stones are so often met with in the course of other abdominal operations or at *post-mortem* examinations without having ever given rise to any symptoms or to any pathological changes in the gall-bladder, that we must conclude that they only cause trouble when they try to escape, when they interfere with the escape of bile or when they give rise to inflammation of the gall-bladder (cholecystitis); this condition has already been dealt with (see p. 125). When a stone tries to escape, its passage along the bile ducts is marked by hepatic colic (see p. 131).

When a stone is impacted in one of the ducts, it may give rise to very severe symptoms quite apart from any cholecystitis that it may cause. If it be impacted in the cystic duct, the gall-bladder behind it will dilate and may contain pus, bile, or a thin mucoid fluid; the blockage usually occurs at the neck of the organ. When the stone is impacted in the common duct, there is well-marked jaundice which is generally absent in cases of impaction in the cystic duct; the depth and severity of the jaundice will vary with the amount of occlusion that the stone produces. The gall-bladder in these cases is usually not distended, and may even shrink up and almost disappear. The occlusion of the bile ducts is rarely brought about by the stone entirely filling the duct in which it lies, the final complete blockage being produced by inflammatory swelling of the mucous membrane. When the stone is impacted in the cystic duct, occlusion may be complete. In the common duct however there may be very considerable dilatation, allowing the bile to find its way into the duodenum alongside the stone, which thus acts somewhat as a ball-valve; the jaundice varies with the completeness of the occlusion.

A stone impacted in either of the ducts may pass on into the bowel if small enough; if it be too large to do this, it may eventually ulcerate through the wall of the duct, which becomes adherent to the bowel, and find its way either into the duodenum or the colon, thus giving rise to a fistulous communication. The symptoms subside as the gall-stone escapes into the bowel, unless of course other stones be present.

COMPLICATIONS.—Cholecystitis and cholangitis have been already referred to (see Chap. XIV.).

Adhesion of the gall-bladder or the bile ducts to surrounding structures is not at all uncommon, and is often accompanied by stricture of the pylorus or intestinal obstruction from kinking of either the colon or the duodenum. Another complication is intestinal obstruction which usually occurs from mechanical blockage by a stone that has found its way into the bowel (see Part VI., Sec. I., p. 365). Suppuration in various situations may follow as the result of suppurative cholecystitis or cholangitis. Thus, it may occur in the sub-phrenic region and may be followed by a fistula about the umbilicus or in the right hypochondrium, or the abscess may burst into the peritoneal cavity. Fistulæ may also occur between the gall-bladder or bile ducts and the pelvis of the kidney, the bladder, or

the vagina. Occasionally the gall-bladder becomes almost obliterated; at other times it may be strictured at its neck and may be dilated with pus without giving rise to any marked symptoms.

SYMPTOMS.—(a) Of stones in the gall-bladder.—As we have already said, the mere presence of stones in the gall-bladder does not necessarily give rise to symptoms. In other cases they either interfere with the outflow of bile and give rise to hydrops or empyema of the gall-bladder or cause cholecystitis.

(b) Of stones passing along the bile passages.—The characteristic symptom to which the passage of gall-stones along the bile ducts gives rise is called *hepatic colic*, which varies from slight vague pains, usually ascribed to stomach-ache, to most acute colic requiring large doses of morphine for its relief. Hepatic colic is most marked when the stone is lodged in the common duct. The pain usually occurs suddenly after a meal or an effort, and is somewhat paroxysmal in nature, the first acute pain being replaced by a dull aching, which in its turn may give place to fresh acute attacks usually referred to the right hypochondrium, but often shooting up into the right shoulder and in bad cases being referred to the whole of the right half of the abdomen; vomiting is frequent. There need be no jaundice except when the stone is impacted in the common duct, in which case it generally supervenes after a few hours.

(c) Of stones impacted in the bile ducts.—*When the stone lies in the cystic duct*, jaundice is exceptional, and the only constant symptoms are dilatation of the gall-bladder and some uneasiness referred to the right hypochondrium. If, however, cholecystitis be present, as it very frequently is at some period of the case, there will be marked pain and tenderness in this region, accompanied by fever from the local peritonitis and a very definite tumour in the region of the gall-bladder. Jaundice may also occur under these conditions owing to the spread of the inflammation from the cystic to the common duct.

When the stone lies in the common duct, the symptoms are much more severe. The pain and tenderness are more marked and there is always jaundice which is often profound, but which varies in intensity from time to time and only ceases definitely when the stone escapes from the duct. There is usually anorexia, accompanied by constipation and vomiting, and, if the case lasts for any length of time, there will be marked cachexia and cholæmia. Even a large stone impacted in the common duct, however, may not always give rise to severe symptoms; there may be only a little occasional colic and some slight jaundice, as the duct may dilate rapidly and allow the bile to pass by the obstruction.

(d) Of complicated cases.—The chief complications are cholecystitis, cholangitis, the presence of adhesions in the neighbourhood of the gall-bladder or bile ducts and the occurrence of intestinal obstruction either from the presence of these adhesions or from the impaction of a gall-stone in the bowel. Cholecystitis and cholangitis have already been discussed (see Chap. XIV.).

Little need be said about the symptoms of adhesions in the neighbourhood of the gall-bladder as they do not necessarily give rise to distinctive troubles unless they cause intestinal obstruction. Their presence however may be suspected when the symptoms point to the long-continued existence of gall-stones accompanied by very considerable dyspeptic symptoms, such as pain after food, flatulence and constipation. It should be remembered that it is not always possible to distinguish between gall-stones and adhesions which compress the bile duct, and cases are occasionally diagnosed and operated upon as gall-stones in which only adhesions are found. The symptoms of obstruction have already been described (see Part VI., Sec. I., p. 365).

Physical examination.—*Palpation of the gall-bladder* should always be practised as it affords valuable information under certain circumstances; in others however it may afford no indication whatever. It is done as follows. The surgeon stands on the right side of the patient, who lies upon the back on a couch with the knees flexed and the pelvis and thorax slightly raised so as to relax the abdominal muscles. The patient breathes regularly and deeply and the surgeon places the left hand flat upon the right lumbar region whilst the right hand is placed over the abdominal wall immediately beneath the costal margin in the neighbourhood of the gall-bladder; *i.e.* the ninth and tenth right costal cartilages. The right hand is now gently and slowly pressed downwards as the patient breathes, whilst the left forcibly pushes up the liver from behind, fixes it and makes it prominent and thus enables deviations from the normal to be appreciated more easily. In this way the presence of tenderness on pressure may be elicited, the outline of a tumour may be ascertained and the amount of movement present on respiration may be made out.

An enlarged gall-bladder is usually easily distinguished from any other enlargement in its neighbourhood. It forms a somewhat pyriform swelling opposite the ninth costal cartilage just outside the edge of the right rectus. It may be sausage-like in shape, it blends with the liver dulness above and, when there are no adhesions, it is freely movable from side to side, but always returns to its place, in which respect it differs from a movable right kidney with which it is not infrequently confounded. When the swelling moves downwards on deep inspiration it cannot be fixed in that position between the two hands during expiration as can a movable kidney or a tumour of the bowel; it invariably slips back into position.

It is important to remember that the physical examination of an enlarged gall-bladder should not go beyond palpation. Puncture should never be resorted to as serious results are likely to follow, owing to the fact that the wall of the organ is often extremely thin and that leakage of septic bile or the escape of pus from an empyematous gall-bladder may take place and may be followed by serious or even fatal peritonitis.

A distended gall-bladder in a patient who does not suffer from jaundice points to some occlusion of the cystic duct. When on the other hand the gall-bladder is distended and there is marked and persistent jaundice, this is

due to a permanent occlusion of the common duct which is perhaps most often due to cancer of the pancreas, duodenum or common bile duct. A stone impacted in the common duct for a considerable time gives rise to persistent but variable jaundice, but here there is no dilatation of the gall-bladder ; on the contrary it may be markedly shrunken.

When there is no tumour to be felt in the region of the gall-bladder and there is no typical hepatic colic, the surgeon must always think of a renal or alimentary origin for the pain that the patient complains of and, before finally making the diagnosis, the past history must be carefully taken into account as, although the patient may have very few symptoms at the time of examination, a history of past attacks of colic followed by the passage of gall-stones and the occurrence of jaundice may be very valuable in throwing light upon the nature of the case.

The relation between gall-stones and jaundice.—Jaundice produced by gall-stones may be due to two distinct causes. On the one hand it may be caused by an inflammatory swelling of the mucous membrane of the common duct, probably set up by the passage of the gall-stones, which interferes with the passage of the bile. This form is usually mild and transitory and probably spreads downwards from the gall-bladder. The other form of jaundice is the deep and persistent variety which occurs when the common duct is blocked. Blockage of this kind is usually due to the impaction of a biliary calculus, but may also arise from the pressure exerted by tumours or from inflammatory affections in the neighbourhood. At the same time it must be remembered that impaction of a gall-stone in the common duct is not necessarily accompanied by persistent or profound jaundice, as the duct dilates above the stone and the latter may merely exert a sort of ball-valve action, slipping upwards occasionally and allowing bile to pass through the duct into the duodenum ; occasionally, owing to the irregular shape of the stone, a channel may be left between it and the wall of the duct along which bile may find its way. It is probable that when jaundice is very profound in these cases complete occlusion is produced not so much by the stone as by the inflammatory swelling of the mucous membrane around it. Jaundice due to an impacted biliary calculus thus differs markedly in some respects from that due to malignant disease, and this is an important point to remember in considering the indications for operation. Jaundice due to malignant disease is very intense and very persistent, and it usually does not vary in intensity except possibly to become steadily deeper.

In bad cases of obstructive jaundice the presence of bile in the blood gives rise to defective coagulating power, and this is a point of great practical importance. It certainly forms a distinct contra-indication to haphazard exploratory operations in cases of obstructive jaundice due to malignant disease. If the cause of the obstruction can be relieved by operation, this want of coagulability of the blood soon passes off ; but where this is impossible the patient has been known in several cases to bleed to

death from the want of coagulating power, and therefore no exploratory operation should be undertaken under these circumstances unless there is a fair chance of relieving the obstruction.

PROGNOSIS.—This is always doubtful even in those who only suffer from occasional attacks of mild colic, and there is no possibility of predicting the course that any given case will run, as a series of very mild attacks may be followed by exceptionally severe complications, while, on the other hand, severe attacks may end in a more or less permanent cure from ulceration of the stone through into the alimentary canal from the gall-bladder or bile duct. The tendency to spontaneous cure is however very slight and as a rule the best that can be hoped from palliative measures is to get comparatively long periods of quiescence.

The prognosis is much improved by early operation, and there is then very slight danger accompanying almost any form of operative interference. This cannot be said of the cases operated upon late in the disease, especially where there are septic complications such as cholangitis or cholecystitis. Even when there are no septic complications but when repeated attacks have led to the occurrence of extensive adhesions, the operation is rendered much more serious, while fever occurring in any case of gall-stones is a bad sign and points to the occurrence of suppurative cholecystitis or cholangitis.

We may divide the cases met with in practice into five large groups :

1. The gall-bladder may contain one or more gall-stones but the cystic duct is quite patent ;
2. The presence of stones in the gall-bladder is complicated by the passage of a gall-stone along the cystic duct ;
3. There may or may not be stones in the gall-bladder but the principal trouble is in the cystic duct which is occluded either by a stone tightly impacted in it or by complete obliteration from inflammatory adhesions or ulceration due to the antecedent passage of a stone. This may lead to one of two conditions : either, (a) *Hydrops of the gall-bladder*, in which the organ contains a glairy, viscid, mucoid fluid ; or (b) *Empyema of the gall-bladder* in which the contents are purulent.
4. The patient may suffer from symptoms due to the passage of a stone along the common duct on its way to the duodenum ;
5. A stone may be permanently impacted in the common duct, being too large to pass through its duodenal orifice ;
6. Cases presenting many of the symptoms of gall-stones are met with in which no gall-stones are found upon opening the abdomen either in the gall-bladder or the bile-ducts, but instead there may be either extensive adhesions external to these structures, or cholecystitis or cholangitis accounting for all the symptoms.

TREATMENT.—The first point for decision in cases of gall-stones is whether operative interference is required, or whether palliative measures are likely to suffice. On this point views differ profoundly. Thus, some advise

operation as soon as gall-stones are diagnosed; others urge that medical measures should be persisted in as long as the stones are in the gall-bladder and there is no marked cholecystitis; whilst others again only operate after a prolonged trial of palliative remedies when life is actually threatened. Our own views are as follows:

Indications for operation.—Whilst palliative measures undoubtedly suffice for mild cases, it must be remembered that it is in the highest degree improbable that they can ever produce more than a prolonged latent period, and they are therefore not curative in the ordinary sense of the term, and a blind adherence to them may end in the surgeon missing the most favourable time for successful operative interference. It is so difficult to gauge the extent of the affection without actually opening the abdomen that no reliable criteria are available as to which cases are really likely to be benefited by palliative measures. In favour of operation is the fact that it removes all the stones and drains the gall-bladder, whereby the probability of subsequent impaction of a stone in one of the ducts is greatly diminished, while any cholecystitis is cured. At the same time, of course, even with cholecystostomy there is no certainty that fresh stones will not form, and even after cholecystectomy it is possible for stones to form in the hepatic duct. Another point of practical importance is that in early cases there is no risk of that serious bleeding which is met with so often in those who are the subject of persistent and profound jaundice.

(a) Palliative.—We should be inclined to say that palliative measures are demanded for the following cases:

1. When there are slight attacks of jaundice occurring at intervals and accompanied by the passage of small gall-stones, palliative measures may be justifiably employed, provided that the patient's health returns to the normal between the attacks and remains good until the next attack occurs. Should the presence of persistent pain in the gall-bladder region or swelling of that organ occur however, or should the attacks be severe and frequent, operative interference will be required.

2. Palliative measures may also be tried in the first instance in cases of impaction of a stone in the common or cystic duct seen immediately after its occurrence, as it is well to allow time to elapse in order to see whether the stone will pass into the duodenum or not. If, after trial of medical measures for a fortnight or three weeks, the stone still remains impacted in the duct, the case becomes one of chronic impaction and demands operation. Should however symptoms, such as fever or enlargement of the liver, occur in the course of an attack of this kind, they point to the occurrence of septic cholangitis (a very serious complication indeed), and operation should be undertaken without delay. Moreover, operation will also be demanded for symptoms indicating localised peritonitis.

3. With non-impacted gall-stones very old and debilitated subjects will probably stand a better chance of prolongation of life by palliative measures, as operation may well prove fatal; if, however, the case be one of a

stone impacted in the common duct with or without any of the various complications already described (see p. 130), operation will be necessary.

4. When there is a doubt as to whether a case of profound and persistent jaundice be due to blockage of the common duct by a stone or to its occlusion by malignant disease, palliative measures should be tried for a few weeks in order to allow sufficient time to elapse for the diagnosis to be made certain. Should the case be one of gall-stones, there will be comparatively little change in the patient's condition in that time; should the mischief however be due to malignant disease, the patient will go downhill rapidly, a tumour will probably become evident in that time, and possibly secondary deposits will be evident elsewhere. On the other hand, if an attempt be made to clear up the diagnosis immediately by an exploratory laparotomy, the patient may no doubt be cured if the case turn out to be one of impaction in the common duct; but should it be malignant disease on the other hand, not only will no good be done, but the patient's life will probably be cut short, as death is very likely to occur from persistent bleeding. When an intensely jaundiced patient has also subcutaneous hæmorrhage resembling purpura hæmorrhagica it will be better not to operate, as fatal bleeding is almost certain to result. It is difficult to ascertain beforehand the likelihood of this serious complication occurring as tests of the coagulating power of the blood are unreliable.

Palliative treatment mainly resolves itself into the treatment of an attack of biliary colic, which is best met by giving a full dose of opium and placing the patient in a bath as hot as can be borne. After immersion in the bath for ten minutes or so the patient should be put to bed and hot fomentations applied all over the abdomen, especially to the hepatic region; leeches to the right hypochondrium are said to give relief when there is tenderness on pressure over that area. As a rule this treatment will suffice for the relief of symptoms of moderate severity but, when the attack is very acute, repeated full doses of morphine are called for, and the best plan is to inject a quarter of a grain subcutaneously as the patient is often sick and cannot retain the drug by mouth. When there is no vomiting, two grains of opium may be given by mouth, combined with half a grain of extract of belladonna repeated as often as necessary. Occasionally in very neurotic patients the attacks are so acute that the administration of a general anæsthetic has to be resorted to.

In the intervals between the attacks of colic the most important line of treatment is to regulate the diet, which should be easily digestible and without an undue amount of nitrogenous material. When the patient suffers from jaundice it is advisable that fatty articles of diet should be very sparingly partaken of as the absorption of fatty food from the intestines under these circumstances takes place very slowly. Saline aperients are generally required and proper exercise must be provided for.

(b) **Operative.**—Operative measures should be employed in the following cases: 1. In acute suppurative cholecystitis. 2. In chronic impaction of a

stone, either in the cystic or the common duct. 3. In cases of severe recurrent colic, particularly when the attacks are so severe as to demand large doses of morphine, and so frequent that there is a risk of the patient becoming the subject of the morphine habit. 4. In cases accompanied by enlargement of the gall-bladder or the liver or by persistent jaundice. 5. In cases accompanied by symptoms of adhesion of the gall-bladder to the stomach, pylorus, colon, etc. 6. In cases marked by symptoms of suppurative cholangitis or perforation of the gall-bladder or bile ducts.

Technique of the preliminary steps of operations upon the bile passages.

—As the early stages of all operative procedures in these cases are similar up to the point where the exact nature of the mischief is made out, we shall make a few preliminary remarks upon them and point out the difficulties that may be met with. It must be remembered that an operation for gall-stones may vary from one of extreme simplicity to one of exceeding difficulty without there being any indication beforehand as to which it will turn out to be. Another important point is that the patient should be directly under the eye of the surgeon who operates for the first week at least after the operation, as many points may arise in the after-treatment with which he can deal best.

The preliminaries for the operation are similar to those for laparotomy (see Part VI., Sec. I., p. 177) and in particular every precaution must be taken against shock as, although in ordinary cases the operation is neither prolonged nor severe, a bad case of stone impacted in the common duct involves a most tedious and difficult operation. One or two precautions are necessary. The bowels should be thoroughly evacuated and the stomach washed out before the operation, both to give room for proper identification and manipulation and more particularly because occasionally the bowel

may have to be opened. When the bile duct has been opened, swabs, sponges or abdominal cloths used for the purpose of absorbing bile should not be used in the later stages of the operation when the abdominal wall is being dealt with.

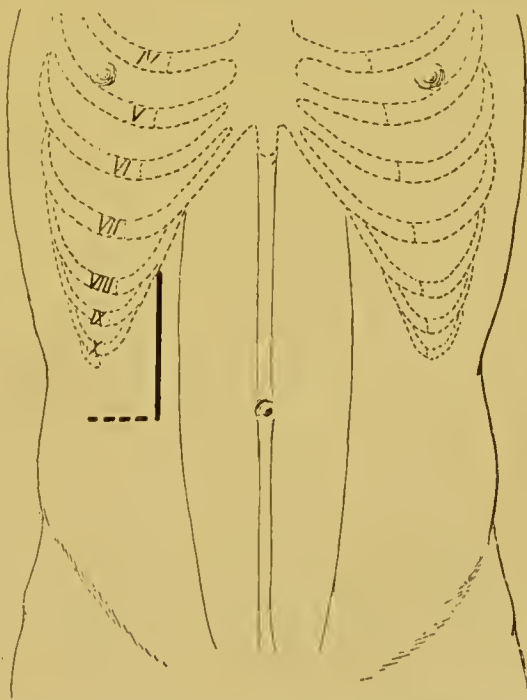


FIG. 29.—THE VERTICAL INCISION FOR OPERATIONS UPON THE GALL-BLADDER. The thick vertical line is the usual incision. The dotted transverse one is added to it when more room is required.

The best incision is a free vertical one from the edge of the ninth or tenth costal cartilages to the level of the umbilicus, and this may have to be prolonged downwards in order to get room (see Fig. 29). A favourite incision is a curved one about an inch below the costal margin, and this may be prolonged outwards into the flank as far as may be necessary and gives abundant room (see Fig. 30). This incision should run at least an inch below the margin of the ribs in order to afford enough room for proper suturing of the abdominal wall afterwards. Other surgeons add a transverse incision to the vertical one first described extending as far

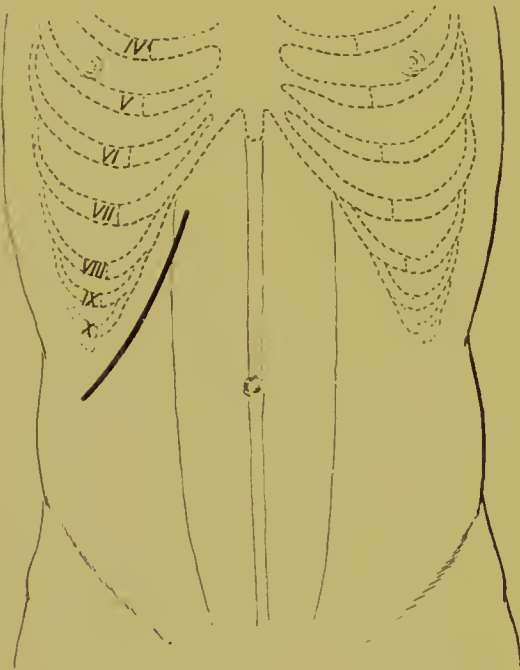


FIG. 30.—THE SUB-COSTAL INCISION FOR GALL-BLADDER OPERATIONS. This must be a full inch below the costal margin.

outwards as may be necessary and thus raising an abdominal flap. In all probability the vertical incision is the best in spare subjects, while the curved one beneath the costal margin may be used in other cases. A very useful incision described by Dr. A. D. Bevan (*Annals of Surgery*, 1899, p. 15) is shown in Fig. 31. It gives abundant room and causes little damage to the abdominal wall.

When there is jaundice, all bleeding points should be ligatured before the peritoneum is opened. If the patient be profoundly jaundiced, the danger of persistent bleeding after the operation is best guarded against by a preliminary administration of chloride of calcium in drachm doses per rectum three times a

day for two or three days before the operation, and also by extra care in picking up and tying bleeding points at the time of the operation, combined with fairly firm packing of the wound at its termination; if necessary, this may be re-inforced by soaking the layers of gauze next the oozing surface in a solution of 1 part of adrenalin chloride in 1000 parts of sterile normal saline solution.

When the peritoneum has been opened, the condition of the parts is examined. If the gall-bladder be not adherent to the anterior abdominal wall, the free edge of the liver is pulled firmly upwards under the ribs and is kept in position by a retractor outside an abdominal cloth. The surgeon then examines for adhesions and notes the condition of the gall-bladder and its walls. Next the cystic duct is examined, both for adhesions and for the presence of a stone. Finally, before settling upon what further is to be done,

the common bile duct should be examined in every case, even when there is no jaundice; this is often easily found as it is only necessary to trace the cystic to its junction with the hepatic duct to form the common bile duct. When however there are numerous adhesions they may obscure the position of the duct; the best plan then is to hook the forefinger into the foramen of Winslow, the anterior margin of which is formed by the common duct. Finally, the pylorus, the duodenum and the pancreas should all be examined to see whether there are adhesions between them and the bile ducts or whether a stone be impacted in them.

We shall now describe in detail the methods applicable to the various conditions that may be met with after the surgeon has opened the abdomen in the above manner.

1. When the gall-bladder is adherent to the abdominal wall the incision through the peritoneum will run partly over the adherent organ and partly into the peritoneal cavity below it. The latter should be carefully packed off and the contents of the viscus drawn off through a small cannula. The opening is then plugged with gauze or a sponge and the gall-bladder and bile ducts are examined by a finger introduced through the incision into the peritoneum and a stone in the cystic or common duct is felt for. Should none be found, the peritoneum is accurately sutured so as to prevent the possibility of infection and the gall-bladder is then laid open and any stones in its interior are removed (*vide infra*). Finally the adherent gall-bladder is drained as in cholecystostomy (see p. 142).

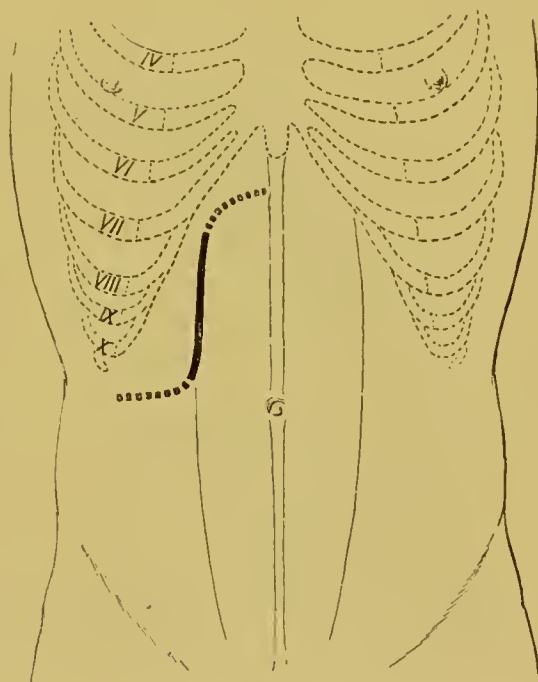


FIG. 31.—BEVAN'S INCISION FOR EXPOSURE OF THE COMMON DUCT. The thick line is the incision that suffices in spare subjects or for gall-bladder operations. The dotted lines show the direction in which the incision is enlarged in order to expose the common duct. (*Annals of Surgery.*)

2. When there is hydrops or empyema of the gall-bladder the condition points to complete occlusion of the cystic duct, and the only certain method of cure is removal of the gall-bladder, as merely opening it and draining it may give rise to a permanent fistula. It may undoubtedly be possible to find and remove a stone blocking the duct through an incision in the fundus and then afterwards to drain the gall-bladder so as to allow the fistula to close spontaneously, but this good result does not necessarily follow, since obliteration of the duct may follow impaction of a stone in it even after

the latter has been removed. Therefore cholecystectomy (see p. 143), is the best operation whenever it is possible.

3. When there are stones in a moderately healthy gall-bladder there are four methods by which the condition of affairs may be dealt with, namely, (a) cholecystotomy; (b) cholecystostomy; (c) cholecystectomy; and (d) cholecystenterostomy.

(a) **Cholecystotomy.**—After the gall-bladder has been exposed and the condition of the parts has been ascertained, abdominal cloths wrung

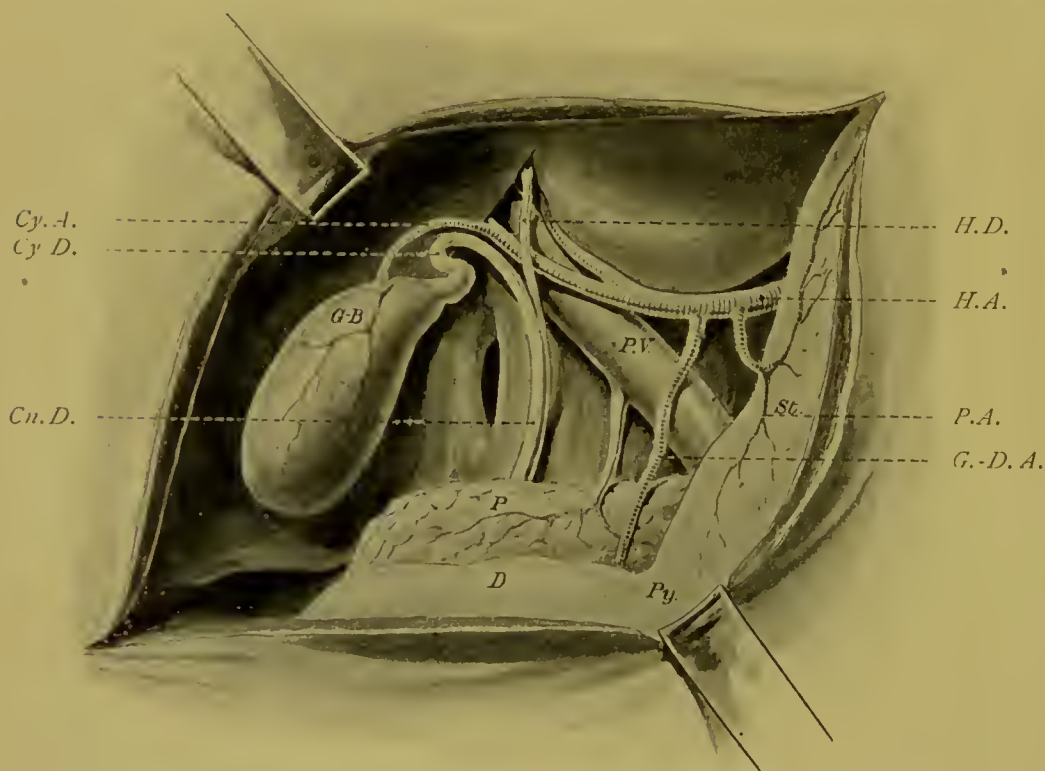


FIG. 32.—THE STRUCTURES SEEN IN THE OPERATIONS UPON THE BILE PASSAGES. The anterior layer of the gastro-hepatic omentum has been removed.

Cy.A.	Cystic artery.	H.D.	Hepatic duct.	Cy.D.	Cystic duct.
Cn.D.	Common duct.	H.A.	Hepatic artery.	P.A.	Pyloric artery.
G.-D.A.	Gastro-duodenal artery.	G.-B.	Gall-bladder.	P	Pancreas.
D.	Duodenum.	St.	Stomach.	P.V.	Portal vein.
Py.	Pylorus.				

(Modified from Bevan, *Annals of Surgery*.)

out of hot salt solution are packed round the gall bladder so as to isolate it from all the surrounding structures. The fundus is drawn well up into or actually out of the wound, and, if the organ be distended, it is well to draw off the bulk of the fluid with a trochar and cannula so as to avoid soiling the wound when the incision is made. The fundus is now laid open and the cut edges of the incision are seized in catch forceps and pulled well up into the wound. Any bile that escapes is rapidly mopped up with suitable swabs. The stones are removed either separately with forceps or with a scoop, and the interior of the gall-bladder is explored with the finger both during and after the evacuation of the stones. When all are apparently removed the fundus is pulled well up, the opening in it is covered

with a piece of wet gauze, and the surgeon purifies his hands afresh and palpates the duct through the abdominal wound to see whether any stone has been pushed into the cystic duct ; it is well also to try and pass a probe along the cystic duct so as to determine its patency, guiding the instrument by the finger outside. When everything is found to be clear, the incision in the gall-bladder is closed by one or two rows of Lembert's sutures and the organ is then dropped back into the abdomen, which is closed as after an ordinary laparotomy. In case leakage should occur, it is well, however, to introduce a drainage tube or gauze packing through the abdominal wound down to the region of the incision in the gall-bladder so that, should re-accumulation occur and the incision in the gall-bladder give way, adhesions will have formed, and the bile will be conducted through the abdominal wound. The drainage tube

is dispensed with in about a week's time. This method is only suited for some cases as the large majority have some inflammatory complication, such as cholecystitis, which requires drainage. Moreover, suture is only possible when the walls of the gall-bladder are fairly thick ; when thin, as they often are, the sutures will certainly penetrate its cavity.

Apart from this also it is very difficult to be certain that the bile passages are clear of stones. The tortuosity of the

cystic duct renders it easy for a stone to escape detection, especially if there be adhesions in the neighbourhood, and the surgeon may erroneously conclude that he has removed all the stones ; if now the gall-bladder be sutured completely without making provision for drainage, fresh accumulation will occur, the stitches may give way, and there will be extravasation into the abdominal cavity, and possibly fatal peritonitis.

(b) **Cholecystostomy.**—In a very large number of cases it is well to provide temporary drainage of the gall-bladder (cholecystostomy), especially when there is an inflammatory condition of the mucous membrane, for the cure of which drainage is necessary. This operation may be done either in two stages or in one. In the former case the gall-bladder is exposed but not opened at the first operation and is merely fixed in position until adhesions have occurred shutting off the peritoneal cavity ; at the second sitting the stones are extracted. In our opinion there is no object in doing the operation in two stages and it has the serious objection that, although the condition of the common duct may have been made out at the first sitting, it is

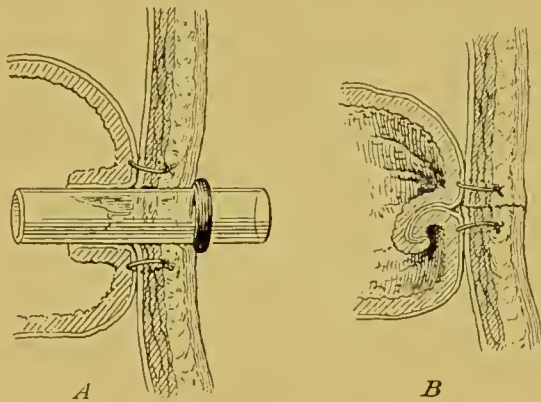


FIG. 33.—DIAGRAM TO ILLUSTRATE THE METHOD OF SUTURING THE GALL-BLADDER IN CHOLECYSTOSTOMY. This is fully described in the text. It shows the valve-like papilla that is formed by the inverted gall-bladder wall when the tube is left out and the opening in the abdominal wall contracts.

possible that a stone may become dislodged during the manipulations and be impacted in the common duct where its presence cannot be ascertained at the second operation, owing to the fact that the peritoneal cavity is now shut off. The best plan is, after having evacuated the stones, to pull the incision in the fundus well up into the abdominal wound and to stitch the peritoneal coat about half an inch from the cut edges to the abdominal peritoneum and transversalis in its upper half; the lower half of the wound is closed as after an ordinary laparotomy. It is important not to suture the edges of the incision in the gall-bladder to the skin of the abdomen, as otherwise a permanent fistula is likely to result. If however they be sutured to the deeper structures in the manner described (see Fig. 33) gradual contraction of the wound takes place, and, unless there be some permanent obstruction to the bile passages, the fistula readily closes after the drainage tube is omitted. The material for suture should be ordinary absorbable catgut. A drainage tube of medium calibre (No. 16) is inserted well into the gall-bladder and packed lightly around with gauze; an ordinary dressing is applied outside.

When the gall-bladder is too adherent or too small to allow of its being sutured to the abdominal wall in this manner, a useful alternative is to open the viscus after having inserted a circular running purse-string suture around the proposed seat of incision as is done previous to the insertion of Murphy's button for lateral anastomosis (see Part VI., Sec. I., p. 263), and then, after removing the stones in the ordinary way, to insert a large gum-elastic tube (No. 18-20), and to tie the purse-string suture tightly around it. The tube is then packed round with gauze, and its end is made to emerge from the abdominal wound. A purse-string suture of this kind holds long enough for adhesions to form all round, and when it cuts its way out and the tube becomes loose, a track will be established through which the contents of the gall-bladder will flow without any risk to the abdominal cavity. It is well to leave the ends of the suture long so as to insure its subsequent removal. This plan is simpler and better than the modification of Murphy's button, recommended for drainage of the gall-bladder in these cases. The great objection to this instrument is that when the gall-bladder is large enough for it to be employed ordinary cholecystostomy by simple suture is possible and much preferable; when the latter cannot be performed, the gall-bladder is usually too small to admit Murphy's instrument.

The *after-treatment* is usually simple. Any shock is suitably treated (see Part I., p. 139), and, beyond this, all that is necessary is to see that the drainage of the gall-bladder is not interfered with for from three to six weeks, according to the necessities of the case. The gauze may be removed at the end of three days, after which the drainage tube alone is employed; this should be kept in position until the discharge is merely clear mucus; the tube may then be left out and the fistula allowed to heal spontaneously.¹

¹ The gall-bladder may be syringed out daily with normal saline solution to keep down the cholecystitis.

Strict asepsis must be maintained, not only at the operation, but throughout the after-treatment, as a suppurating gall-bladder is a troublesome complication. Should the fistula not heal in two or three months the case becomes one of biliary fistula, which is dealt with separately (see p. 151).

(c) **Cholecystectomy.**—An excellent plan in many cases is excision of the gall-bladder, together with the stones contained in it. Any adhesions between the gall-bladder and the intestine are first of all separated, and then the gall-bladder is separated from the liver; this may be begun either at the neck or the fundus according to the condition of the parts. It will generally be best to commence at the fundus and proceed from before backwards, but, if there be many adhesions binding down the fundus, the operation will be facilitated by separating the cystic duct first, clamping and dividing it between two pair of forceps, and then stripping up the gall-bladder from the liver from behind forwards. As much of the peritoneum as possible should be raised from the under surface of the gall-bladder and left behind in order that it may be laid down afterwards so as to minimise the raw surface left; otherwise adhesion of the intestines to the under surface of the liver may take place over a comparatively large area. The best way is to make a horse-shoe shaped incision through the peritoneum covering the under surface of the organ with its convexity forwards. The neck of the gall-bladder should always be clamped as a preliminary, in order to prevent stones being pushed into the cystic duct during the manipulations necessary to separate the gall-bladder from the liver.

It will sometimes happen that the adhesions between the gall-bladder and the under surface of the liver are so firm that the two structures cannot be separated. When this is the case, as much as possible of the fundus should be cut away and then the whole of the mucous membrane remaining is carefully clipped away with scissors.

The next point is the treatment of the open end of the divided cystic duct. If this be sufficiently large and the parts sufficiently accessible, it may be treated in the same way as the stump of an appendix (see Part VI., Sec. I., p. 391) or, if this be impossible, it may be covered by a flap of peritoneum from the adjacent regions.¹ It is always well to leave the upper part of the abdominal wound open and to insert a tube or a gauze drain down to the duct. The principal reason for this is that free oozing may follow the detachment of the gall-bladder from the liver; there is also always the possibility of septic infection from the duct. Possibly also a stone may be lodged in the common duct and may have been overlooked, in which case there will be leakage from the cystic duct after the ligature separates.

(d) **Cholecystenterostomy.**—Some of the American surgeons recommend that the operation of cholecystenterostomy, or anastomosing the gall-bladder

¹ If it be impossible to cover the divided end of the duct, it may be closed by one or two sutures, and a very good plan is to pass a drainage tube down so that the end of the duct lies within the end of the tube; the latter is then packed around with gauze.

to the bowel, should be undertaken in simple cases of stones in the gall-bladder. Although this operation undoubtedly may have a legitimate field under other circumstances, we can hardly think that it is called for in the case of stones in the gall-bladder only, because, quite apart from the question of septic infection of the bile passages following the operation, the procedure is more difficult than the methods above described. The steps of the operation will be found on p. 151.

*We may sum up the relative merits of these operations, as applied to the condition we are considering, as follows:—*In the majority of cases the choice really lies between cholecystostomy and cholecystectomy, and undoubtedly the latter operation is the ideal one as it not only gets rid of the stones present but also removes any cholecystitis, and it is highly improbable that gall-stones will ever form again after it as there is only the hepatic duct left for them to form in. On the other hand, the operation is admittedly one of some severity and cannot always be employed. We would recommend that cholecystectomy should be done in all cases where the adhesions are slight and the patient's condition warrants the operation. The surgeon must also be certain that there are no stones present in the common duct. A stone in the cystic duct is no contra-indication to the operation, as removal of the cystic duct may be combined with the cholecystectomy.

Cholecystostomy on the other hand should be employed where there are extensive adhesions of the gall-bladder, where the patient is too feeble to stand extirpation, when there is much cholecystitis, and when there is any doubt as to whether the common duct is free from stones.

The ideal operation, or cholecystotomy, is only available in a small number of cases. We have done it successfully in two or three cases where there was very little cholecystitis, where the walls of the gall-bladder were moderately thick, and where it was certain that there were no other stones present either in the cystic or the common duct. We have discussed the question of cholecystenterostomy above.

4. When there are gall-stones in a much altered and adherent gall-bladder but the bile ducts are free.—Here the surgeon has the choice of two methods, either to drain the gall-bladder as long as may be necessary, or to remove it entirely. Of these the latter procedure is preferable, but if the gall-bladder be very adherent it may be impossible, and cholecystostomy will then be necessary. Both operations have already been described (see p. 141).

5. When there is a stone impacted in the cystic duct, the surgeon will go on, after removing any stones in the gall-bladder, to remove that in the duct. Suitable fine forceps or a scoop may first be introduced through the opening in the fundus and guided to the cystic duct by the fingers passed in through the abdominal wound and palpating the duct from the outside. In this way attempts are made to guide the forceps or the scoop along the duct and by it to withdraw the stone; these attempts may

sometimes be aided by pushing the stone up towards the neck of the gall-bladder. If this fails and the stone be very soft, gentle pressure between the fingers outside the duct may break it up and allow the fragments to be removed with the scoop. Should there be any difficulty in removing it in this manner, however, there are two plans open to the surgeon. In one an incision is made directly over the stone and the latter removed, taking care to make the opening somewhat on the hepatic aspect of the duct so as to secure adhesions between the incision and the liver and not between it and the stomach. After removal of the stone, the cut edges are united by Lembert sutures of fine catgut, and the opening in the fundus is sutured to the abdominal wall and drained as in cholecystostomy.

The other and more rational method is to remove the gall-bladder and the cystic duct together with the stones in them. This operation—cholecystectomy—has already been described (see p. 143), and we should recommend it for all cases except where adhesions or the condition of the patient render extraction of the stone through an incision in the duct imperative. Cholecystectomy has the great advantage that no biliary fistula is likely to follow it, whereas this may happen after removal of a stone from the cystic duct, as the inflammatory condition produced by the impaction of the stone may end in a cicatricial stricture of the duct, which will give rise to a permanent fistula if cholecystostomy be performed. Moreover, it is more difficult to suture an incision in the cystic duct than to deal with its divided end.

6. When a stone is permanently impacted in the common duct.—When examination detects a stone impacted in the common duct, an attempt should first be made to remove it by incising the common duct directly over the stone,—choledochotomy.

Choledochotomy.—The laparotomy incision will generally need to be lengthened, often considerably in fat subjects, in order to get proper access to the duct. If the condition of affairs be suspected before operation, it is well to employ the curved incision below the costal margin in all except spare subjects. As the shock may be extreme, the most energetic measures should be taken to combat it (see Part VI., Sec. I., p. 177).

After the incision has been enlarged, the surrounding parts must be displaced as far as possible so as to give a good view of the common duct, and the best way to effect this is to pull up the anterior edge of the liver rotating it upon itself around its transverse axis; the common duct is thus brought about an inch nearer to the surface than it usually lies. It is also a good plan to raise the trunk¹ so as to allow the intestines to fall downwards by their own weight; they may be kept out of the way by a retractor applied outside an abdominal cloth and are packed off by abdominal

¹A firm round bolster or a large sandbag should be placed beneath the upper part of the loins in such a way as to arch the back fully. This throws the liver well upwards into the thorax while the intestines fall downwards towards the pelvis. The suggestion is due to Mr. Mayo Robson and is a very valuable one.

cloths so that the whole area around is protected. It is important to see that packing is thrust well into the foramen of Winslow.

The next point is to trace the cystic down to the common duct, separating adhesions to facilitate the identification of the latter structure. While doing this, careful watch must be kept for any fistulous communication between the gall-bladder and the bowel; if one exists and it be accidentally opened, it must receive suitable treatment either by re-uniting the fistula or, better, by removing the gall-bladder entirely, if possible, and then closing the aperture in the bowel in the ordinary way (see Part VI., Sec. I., p. 305). The identification of the common duct has already been dealt with (see p. 139). When the position of the stone has been made out, the packing is readjusted so as to make sure that no bile can escape into the peritoneal cavity. The exact procedure for the removal of the stone will vary somewhat according to its position in the duct.

When the stone lies in the first part of the common duct, the incision will be above the pancreas and the duodenum, and may be made directly over the stone throughout its full length in front, and the calculus is then easily removed. It is important in doing this to fix the stone so that it does not slip about, as in some cases the duct is dilated and the stone slips about like a ball-valve and may easily be pushed up into the hepatic duct where it is very difficult of access. The best plan is to introduce the finger through the foramen of Winslow, hook it round behind the stone, and press the latter forcibly forward so that it is firmly fixed. In making the incision into the common duct it is very useful, if there be but few adhesions, to incise first the peritoneal covering and then the wall of the duct separately; this facilitates the introduction of the stitches subsequently. If there be many adhesions there will be no distinction between the peritoneal covering and the duct wall.

When the stone lies in the second part of the duct, the best plan is to attempt to squeeze it up into the first part and cut down upon it there (*vide supra*). Should this fail, the duct must be incised as near to the stone as the surgeon can reach without damaging either the duodenum or the pancreas, these structures being stripped downwards as far as possible. A suitable pair of forceps or a scoop is passed into the incision and the stone extracted whole if possible, or, if not, in fragments.

Two other methods have been suggested for the removal of stones in this situation, so as to avoid incising the common duct. In one the stone is firmly squeezed between the fingers so that, if it be friable, it is crushed into fragments, in the hope that these may pass on into the duodenum and so the affection may be cured. A somewhat similar plan is to pass a stout needle obliquely through the walls of the duct down into the stone which is thus split up into fragments which may be further reduced by pressure between the fingers and then left to pass into the intestine. There are many objections to these methods and they are not to be recommended. The pressure may cause serious bruising, and the needling

may cause infection. On the other hand, even though successful, the affection may not be cured thereby, as only part of the débris may pass into the duodenum, and the remainder may form the nuclei of fresh stones.

Incision of the common duct is followed by the escape of bile, sometimes in very large quantities. When the duct is much dilated, it is well to make a small incision into it in the first instance, so as to avoid having the wound flooded with a large quantity of bile. As the latter escapes, it is rapidly mopped up with sterilised pads, which should be at hand in large numbers and should not be used a second time. When all the bile has escaped, the incision may be enlarged, and the stone removed as mentioned above; the next point is to palpate the whole duct and then to introduce a probe and to explore it in both directions, upwards and downwards, to see whether any more stones are present.

Suture of the duct may be performed in several ways, and varies greatly in the ease with which it can be done according to the depth at which the duct lies from the surface. The fullest possible retraction of the wound should be effected by the assistant, the free edge of the liver should be drawn up and the duodenum pushed downwards as far as possible. A good light and especially good sponging are essential, as the escape of bile and the troublesome oozing from the plexus of veins (see p. 105) lying over the common duct may hamper the surgeon very much. The fine needles recommended by Mr. Arbuthnot Lane for cleft-palate operations, passed by means of the special needle-holder, are often useful for suture. Others, like Mr. Mayo Robson, use a rectangular cleft-palate needle. Others again prefer fine, curved Hagedorn needles. Halsted has introduced a series of ingenious metal hammers for the purpose of distending the duct, pulling it well up into the wound and steadying it there while suture is being performed, but we have found no special advantage from their use, and shall not therefore describe them further. We prefer to press forward the duct with the forefinger in the foramen of Winslow, and to use curved needles in a suitable needle holder. We always try to avoid taking up the mucous membrane of the duct in the stitch, but this is not always possible. Two rows of interrupted catgut sutures should be inserted, the first layer through the walls of the duct and the second through its peritoneal covering whenever it is possible to differentiate between these two structures. Perfect closure of the incision may be obtained in this manner, and no leakage of bile is likely to take place; when there are many adhesions however, the distinction between the two structures will not be marked and one layer of sutures will suffice.

In our opinion good drainage should always be provided even after most accurate suture. After stitching the duct the best plan is to insert a tube the size of the thumb down to but not actually touching the duct, and to pack gauze lightly around it, making both tube and gauze emerge from one end of the abdominal wound, the remainder of which is sewn up as after an ordinary laparotomy. The tube must not actually touch the duct or it might

compress it and interfere with the flow of bile. It is not at all uncommon to find after choledochotomy that jaundice becomes marked where it had previously been slight, probably owing either to some swelling of the mucous membrane of the common duct or from too tight suturing. This however usually passes off in a short time. The object of the gauze is to set up adhesions all around the operation area, which it does in a very few hours, so that a definite track is left along which any extravasated material may find its way without any risk to the peritoneal cavity.

Whenever there is acute cholangitis or any doubt as to whether the patient can stand the necessary prolongation of the operation, suture of the duct may be dispensed with safely if drainage be provided. This is done in the same way as after suture of the duct, except that special care must be taken to pack off the area around so that the drainage tube is surrounded by a barrier of gauze. The end of the tube should lie over the opening in the duct itself, so that bile does not find its way anywhere except along the tube.

Some surgeons advise that a cholecystostomy should always be combined with a choledochotomy, so as to drain the gall-bladder and cure any cholecystitis and thus to minimise the likelihood of recurrence of stone. On this point the surgeon will be guided largely by the condition he finds. If the gall-bladder be large and inflamed, and also if it contain stones, it is well to secure the fundus in the upper angle of the wound (see p. 141) and drain it. It is often impossible however to drain the organ, as it is shrunk, and no attempt need then be made to do so provided that it contains no stones; cholecystectomy, which would be the ideal method under these circumstances, will rarely be permissible on account of the patient's condition. It is perhaps well not to perform cholecystostomy in cases marked by severe bleeding, as the fewer incisions made into mucous membrane under these circumstances the better.

After choledochotomy the abdominal wall should be united in three stages in the ordinary manner right up to where the packing emerges, and it is always well to insert a suitable number of silkworm gut stitches, taking up all the structures through the part of the abdominal wall where the packing comes out, so that, should no leakage occur from the sutured duct, they may be brought together subsequently and a ventral hernia avoided. The gauze is left out after the first dressing, which should be done about the second or third day under gas. The drainage tube is kept in until it is clear that the common duct has healed.

When the stone is impacted in the terminal third of the duct, especially when it lies in the ampulla of Vater, it is out of the question to incise the duct directly over the stone without injuring the duodenum. The surgeon has several courses open to him. In the first place he may attempt to squeeze the stone higher up in the duct which may then be incised, as recommended above; this however is not usually successful. Others have attempted to crush or to needle the stone, but this has disadvantages that have already been referred to (see p. 146) and we cannot recommend it. The method

we should advise, when an attempt to push up the stone has failed, is to incise the anterior wall of the duodenum directly down upon the stone by making an incision parallel to its long axis over the situation of the orifice of the duct, and then cutting directly down upon and extracting the stone through the mucous membrane of the posterior duodenal wall. This operation can only be done when the patient is in good condition. Before the incision is made into its anterior wall the duodenum should be clamped if possible on either side with Lane's intestinal clamps and emptied of its contents. If it be impossible to clamp it, it should be squeezed empty and occluded by the pressure of an assistant's fingers until the incision has been made, when the edges of the incision are held apart and pads of wool are pushed in on either side in order to prevent the escape of its contents. The posterior wall is now slit up from the orifice of the small papilla in which the duct ends; if that be indistinguishable, the surgeon cuts down directly over the stone. In slitting up or incising the duct in this manner it is very important not to carry the incision too high up or else the cellular tissue behind the duodenum may be opened up. After the incision has been made, the stone is easily removed with a suitable pair of forceps or with a scoop. A probe is then passed up along the duct to see if a second stone be present, which should be squeezed downwards; this is not very important as in any case it would probably pass through the enlarged orifice of the duct. The pads are removed and the incision in the duct and the mucous membrane of the posterior wall of the duodenum is left unsutured; that through the anterior wall is closed as after enterotomy (see Part VI., Sec. I., p. 366).

When choledochotomy is impossible on account of the extent of the adhesions, the depth of the duct or the weak state of the patient, something must be done to relieve the blockage of the bile duct, and the simplest plan is to open the gall-bladder. If the obstruction to the duct be removable but the patient's condition is too bad to allow this to be done and time is of the utmost importance, a cholecystostomy (see p. 141) should be performed with the idea of possibly doing choledochotomy at a subsequent period, in which case the abdomen will be opened by a fresh incision and the stone removed. The biliary fistula resulting from the cholecystostomy will then gradually close, but this temporary plan should never be resorted to unless it is absolutely necessary, for two principal reasons. The first is that a stone in a fairly accessible situation at the time of the first operation may shift its position and become impacted further down, so that the subsequent operation is much increased in difficulty. Moreover the adhesions resulting from the cholecystostomy will almost certainly seriously interfere with the subsequent operation. Therefore if choledochotomy can be performed it should be done in the first instance if possible. The question of doing a cholecystenterostomy (*vide infra*) must also be considered.

After-treatment.—The after-treatment is in the main that for any severe laparotomy, and is especially directed to the relief of shock (see Part VI.,

Sec. I., p. 217). If a biliary fistula forms, it may be allowed to heal gradually, which it usually does when there is no obstruction to the ducts. It may break open once or twice, possibly from some slight recrudescence of cholangitis, but healing usually remains quite sound after three months.

When cholecystostomy has been done as a temporary measure because choledochotomy cannot be performed, some surgeons recommend that a quantity of warm olive oil, about an ounce to an ounce and a half, should be syringed gently down the sinus once or twice daily, and at the same time olive oil should be given internally in doses as large and as frequently repeated as the patient can tolerate. This is said to have a solvent effect upon the calculus and to facilitate its passage along the duct, but we are unable to satisfy ourselves of the truth of this.

The general treatment consists largely in taking measures designed to avoid broncho-pneumonia or pleurisy, which are fairly frequent affections, probably owing to the immobility of the diaphragm and the bases of the lungs. Another not at all uncommon complication is said to be acute dilatation of the stomach. Lung complications are guarded against by propping the patient up, by change of posture, and by the administration of suitable diffusible stimulants, whilst dilatation of the stomach may be treated by washing out the organ, feeding *per rectum*, and administering strychnine.

An occasional trouble is excessive bleeding, to which we have already referred (see p. 138), and this may necessitate re-opening the wound for its arrest. It is most commonly met with after cholecystectomy, the oozing taking place from the raw surface of the liver, and it may be met partly by the continued administration of chloride of calcium by the rectum, partly by soaking the deeper layers of the gauze packing in a solution of adrenalin chloride (1 in 1000), or, if that fails, by opening the wound and applying firm pressure, or, failing that, under running bleeding vessels or applying the actual cautery. The wound may also have to be opened up after cholecystostomy in order to remove stitches, about which fresh biliary calculi are forming. This trouble can easily be avoided if the stitches be either of the ordinary absorbable catgut with the ends cut short, or of silkworm gut with the ends cut long so that they can be reached and removed without opening up the wound. Another cause for which the wound occasionally wants re-opening, and a very serious and troublesome complication, is the formation of dense adhesions between the seat of the operation and the duodenum, pylorus, or colon; occasionally actual stricture of the bowel may thus be produced. Later on operation may be required for ventral hernia or for persistent biliary fistula (*vide infra*).

Results.—If the patient perseveres with suitable hygienic means, diet, exercise, etc., after a successful operation, the results both immediate and remote are very good, and recurrence is rare.

Cholecystenterostomy.—Another operation recommended for cases in which the patient's condition does not allow of choledochotomy is called cholecystenterostomy and has for its object the establishment of a

fistulous communication between the gall-bladder and the intestine, preferably the duodenum or, failing that, the colon. The object of this operation is to avoid a biliary fistula, which of course will be permanent if it be impossible to remove the stone from the duct or if the obstruction happen to be malignant. Exceedingly good results have been claimed for the operation by Murphy, Abbe and others but personally we should much prefer, when choledochotomy cannot be done at the original laparotomy but the stone appears to be removable at a second, to do a cholecystostomy and to defer attempts to remove the stone to a later date. We should reserve cholecystenterostomy for cases in which the obstruction is irremovable.

The operation of cholecystenterostomy is performed much as is gastro-enterostomy (see Part VI., Sec. I., p. 249), the contents of the gall-bladder being first removed by a trochar and cannula. It is well however not to use a first layer of stitches uniting the mucous membrane of the gall-bladder to that of the intestine, as is done in gastro-enterostomy, as these stitches are said to become the nuclei of stones. A single continuous Lembert suture reinforced by a few interrupted stitches outside will suffice. Murphy uses his button but we prefer simple suture. In putting in the stitches care must be taken that they do not penetrate the gall-bladder cavity. If the walls of the viscus be so thin as to render this inevitable, it is possible that a Murphy's button would be a more suitable method. There is also less objection to the use of the button when the anastomosis is made with the colon, especially if a button with flanges of unequal size be used (see Part VI., Sec. I., p. 267).

When the gall-bladder is extremely small and the common duct is widely dilated a suggestion is to anastomose the common bile duct with the duodenum—choledocho-duodenostomy—but this is not likely to be often feasible. It is done in a similar manner to the above, only from the depth of the parts, etc., it is much more difficult.

BILIARY FISTULA.

It not infrequently happens that a patient, either as a result of operative interference or from the spontaneous rupture of a gall-bladder abscess, suffers from a biliary fistula, which will be permanent unless surgical intervention be undertaken for its cure. Biliary fistula may be due to one of the following causes :

1. Gall-stones impacted in the cystic duct.
2. Kinking of the cystic duct as a result of suturing the fundus in bad position in cholecystostomy or from adhesions about the neck of the gall-bladder or the cystic duct.
3. Obliteration of the cystic duct by inflammation.
4. Want of closure of a cholecystostomy wound as a result of suturing the incision in the gall-bladder to the skin instead of to the deeper structures (see p. 142).

5. Gall stones impacted in the common duct.

6. Occlusion of the common duct by new growths, cicatrices, etc.

A persistent biliary fistula is of course a most unpleasant condition. When the trouble is in the cystic duct, the discharge from the fistula as a rule is merely a thin, mucoid fluid. When, however, it is in the common duct, bile often pours out of the fistula in large quantities. Although a non-biliary fistula does not cause irritation of the skin around, it is very inconvenient to the patient and requires constant attention, whilst a true biliary fistula may give rise not only to much annoyance from staining of the linen, but to irritation of the skin around by the bile. Therefore in the majority of cases surgical intervention will be called for.

TREATMENT.—1. When the fistula is due to a stone impacted in the cystic duct, attempts should first be made to localise the stone by a probe and then to extract it with suitable forceps from the wound. Should this fail, the surgeon must open the abdomen and do a cholecystectomy if the condition of affairs permits (see p. 143); if not, the stone should be extracted through an incision directly over it, and then the entire mucous membrane should be removed from the gall-bladder and the cystic duct by cutting or scraping. Finally, drainage is provided until the cavity closes, as it will do if the mucous membrane be entirely removed.

2. When the fistula is due to kinking of the cystic duct or the neck of the gall-bladder, a laparotomy should be performed, the fundus freed from the abdominal wall and then, if the condition of affairs permits, a cholecystectomy should be done, the cystic duct being removed with the gall-bladder (see p. 143). Should this operation be considered inadvisable (see p. 144), a laparotomy should be done, the fundus freed and then, after making quite sure that no stones are present in the gall-bladder or the cystic duct, the edges of the incision in the fundus are pared and united by Lembert's sutures, and the gall-bladder is dropped back into the abdomen, drainage being provided down to the seat of operation (see p. 141). When the fistula is due to adhesions about the cystic duct or the neck of the gall-bladder the only really satisfactory treatment is a cholecystectomy.

3. When the fistula is due to stricture of the cystic duct, complete extirpation of the gall-bladder is indicated.

4. When the fistula is due to want of closure from faulty suture after cholecystostomy a laparotomy should be done, the fundus separated from the abdominal wall, its edges pared freely and the wound in the gall-bladder closed by Lembert's sutures in the ordinary fashion. The sutured gall-bladder should then be dropped back into the abdomen, drainage being provided down to the seat of operation (see p. 141).

5. When the fistula is due to a stone impacted in the common duct, and attempts to get the stone passed on by the injection of warm olive oil and subsequently plugging the fistulous orifice are persevered with in vain for, say, three months, abdominal section should be performed and choledochotomy undertaken. Should that prove impossible, cholecystenterostomy may be done.

6. When the fistula is due to the occlusion of the common duct by a new growth, the tumour will be of a malignant nature and hence the advantage to be gained from operative interference for the cure of the fistula, which could only take the form of cholecystenterostomy, does not counterbalance the risks. A biliary fistula due to this cause should rarely be met with as, when the abdomen has been opened and a malignant growth occluding the common duct has been found, it will be better either to leave the case alone or to do a cholecystenterostomy in preference to a cholecystostomy.

When the fistula follows stenosis of the duct due to rupture from injury and subsequent cicatricial contraction the outlook is better, as, although it may be impossible to render the duct patent again, the flow of bile may be diverted from the fistula into the intestine by doing a cholecystenterostomy. The fistula should then close, and the patient will be relieved of his trouble.

CHAPTER XVI.

THE SURGICAL AFFECTIONS OF THE SPLEEN.

TRAUMATIC AFFECTIONS OF THE SPLEEN.

INJURIES of this organ are rare, except in connection with severe abdominal crushes. They may be divided into penetrating wounds and contusions or ruptures. *Penetrating wounds* are comparatively seldom met with, owing to the sheltered position of the organ beneath the ribs, and are generally caused by firearms. *Contusions and ruptures of the spleen* are more common, and are caused either by severe blows—such as a kick from a horse or a run-over accident—or from a comparatively slight injury to a previously enlarged spleen. Except in the last variety, rupture is usually accompanied by other lesions, and the outlook is very grave. When the injury is comparatively slight there may be merely extravasation of blood within the capsule of the organ, but in more severe cases the spleen is partially or entirely ruptured, or even in bad cases completely pulped up; these cases are followed by almost immediate death from hæmorrhage. Indeed, when the serous envelope of the spleen is torn, death from hæmorrhage is liable to follow, if not immediately, at any rate in a comparatively short time.

SYMPTOMS.—The symptoms of rupture of the spleen are profound shock and signs of intra-abdominal hæmorrhage. The diagnosis as to the exact organ injured will depend partly on the severity of the hæmorrhage, because bleeding from the spleen is always more severe than from any other organ, and partly on the fact that there has been an injury in the splenic region; if the patient be known to suffer from an enlarged spleen the probability of that being the organ injured is much increased. There is often tenderness and an increase of dulness in the splenic area.

TREATMENT.—When the patient survives long enough, the abdomen must be opened and the injured organ dealt with. In a good many cases the abdomen is opened without exact knowledge of the injury, and

it is only in the course of a search for the source of the bleeding that the diagnosis of ruptured spleen is made. The first question that arises in the treatment is whether the abdomen should be opened at once, or whether an interval should be allowed to elapse for the patient to recover from the shock. Undoubtedly the longer the time that elapses the greater is the bleeding, and consequently the worse the chance of recovery. At the same time, if the patient be profoundly collapsed and the diagnosis be uncertain, it may be best to wait for a short time and to employ remedies against the shock before proceeding to operate. On the other hand, if the case be clearly one of hæmorrhage, the only chance of saving the patient will be to open the abdomen and clamp the pedicle of the spleen, trusting to intra-venous saline infusion to restore the circulation.

If it be recognised that the spleen is the organ ruptured, the best incision is one parallel with and an inch below the left costal margin. In cases of uncertain diagnosis, however, the incision should be in the middle line, and, if large enough, this gives good access to the spleen unless the patient be very stout; in that case a transverse incision outwards to the left, just above the umbilicus, may be added.

When the abdomen has been opened, the clot is rapidly turned out, the hand is slipped in, the spleen is felt for, and its pedicle is compressed between the finger and thumb, so as to stop the bleeding. An assistant clears away the blood with sponges, so that the lesion in the organ may be examined and further treatment decided upon.

If there be merely *a rent in the capsule of the spleen*, or a small penetrating wound, an attempt may be made to arrest the bleeding by passing deep catgut sutures through the spleen at least an inch from the cut surface on each side, so as to compress the splenic tissue thoroughly, as is done to arrest hæmorrhage from the liver (see Chap. XII.). After this has been done, the wound is kept open a short time to see that all bleeding has stopped and the spleen is examined to make sure that there is no second wound.

In the great majority of cases, however, there is *a severe contusion or a rupture*, and the only treatment is to remove the spleen; the operation is described elsewhere (see p. 159). The first step is to clamp the pedicle with long powerful pressure forceps, and then to rapidly remove the organ, taking care not to cut the pedicle too close to the forceps. The extravasated blood is then removed, the parts cleaned up, and the pedicle secured permanently as for splenectomy (see p. 160). The chief point of importance is to clamp the pedicle as early as possible, so as to avoid further loss of blood. During or after the operation it will probably be found necessary to administer an intra-venous infusion of saline solution (see Part I., p. 136).

Unless the patient has lost too much blood, recovery is usually quite satisfactory, and during it the superficial glands generally enlarge and remain hypertrophied. Occasionally, however, the loss of the spleen has

led to serious symptoms; for example, a patient from whom Mr. Ballance removed the spleen for injury began, after convalescence, to go downhill with weakness, emaciation, thirst, and drowsiness. She was given extract of sheep's spleen and raw bone marrow daily, and recovered completely. In another very similar recorded case cod-liver oil and bone marrow, and, subsequently, arsenic, were administered with good results.

PROLAPSE OF THE SPLEEN.

When there is a large penetrating wound over the splenic region the spleen may prolapse, and the question will arise as to the best method of treatment. If the organ be uninjured, it should of course be purified and returned into the abdomen, but in most cases it will be damaged and bleeding freely. If the wound in the spleen be slight, it may be secured and the organ returned just within the abdomen and possibly sutured to the parietal peritoneum, but the softness of its substance renders any real compression very difficult, and there will probably be no alternative but to remove the spleen; for the details of the operation see p. 159.

WANDERING SPLEEN.

This condition is not at all uncommon. It occasionally follows injury, but more frequently arises spontaneously, the attachments of the spleen becoming unduly stretched. Indeed, the pedicle may be converted into a cord which may become twisted and may give rise to gangrene of the organ. The degree of mobility varies; sometimes the spleen merely moves out from under the ribs for a short distance, whilst in bad cases it wanders widely over the abdomen, especially towards the left iliac fossa; it has even been found in the pelvis.

A wandering spleen is generally also enlarged, and the enlargement may either be the primary cause of the mischief, or it may be secondary to the undue mobility as a result of the repeated congestion caused by kinking of the pedicle.

SYMPTOMS.—These are comparatively few and are mainly a slight pain and uneasiness about the left side, with occasional intestinal symptoms from pressure. The only condition from which the affection requires to be diagnosed is movable left kidney. The size and shape of the organ should, however, render the diagnosis easy; it is generally possible to feel the notch in the anterior margin of the spleen.

TREATMENT.—*In mild cases without marked pain* the best plan is to try a well-fitting belt, which in many cases suffices to cure the slight troubles of which the patient complains.

In severe cases more radical measures are required, and here the surgeon has the choice between two methods; on the one hand the so-called splenopexy, or fixation of the organ in its proper position, and on

the other, the radical one of splenectomy. The latter is of course a radical cure, and the results obtained by it are very favourable, except when there is some primary disease of the spleen. At the same time, the operation is undoubtedly serious, and is only called for when the patient is gravely incapacitated and no other measures suffice, as, apart from the risks of the operation itself (*vide infra*), the mere loss of the spleen may affect the patient deleteriously.

The operation of splenopexy is somewhat complicated if it is to be done efficiently. It is not sufficient simply to pass sutures through the capsule of the spleen and the under surface of the diaphragm, as no satisfactory adhesions result and the spleen soon becomes loose again. Hence a more elaborate operation is required; the following ingenious plan has been carried out with success by Rydygier (*Archiv f. klin. Chir.*, 1895), and we have had a successful result with it in one case.

Splenopexy—The abdomen is opened by a vertical incision either in the middle line or in the left linea semilunaris and the spleen is exposed and raised into its normal position. In order to keep it there, a pocket is made beneath the parietal peritoneum into which the lower end of the organ is inserted and fixed. To do this, a transverse incision is made through the peritoneum on a level with the junction of the upper with the middle third of the spleen in its normal position, and the peritoneum is separated from the abdominal wall downwards with the finger or the handle of the knife so as to form a pocket to receive the spleen. In order to limit the separation of the peritoneum from the wall of the abdomen below and to prevent the spleen increasing this separation by its weight and slipping too far down in the pocket, a few stitches may be passed through the parietal peritoneum and the subjacent muscles along a horizontal line marking out the lower limit of the pocket. Into the pocket thus made the lower part of the spleen is placed, and the free border of the pocket is fastened to the gastro-splenic omentum by a few catgut sutures.

This operation, however, is only suitable for cases of wandering spleen that have not undergone any marked enlargement. An enlarged spleen would be likely to drag downwards again by its weight, and in these cases, therefore, splenectomy (see p. 159) must be done.

INFLAMMATORY AFFECTIONS OF THE SPLEEN.

Inflammation and abscess of the spleen usually follow some general septic infection and therefore form part of a general disease and are not directly amenable to surgical treatment.

ABSCESS OF THE SPLEEN has however been met with as an independent affection, for instance following typhoid fever, but its diagnosis is naturally extremely difficult. There is pain over the spleen and tenderness on deep pressure accompanied by fever and the usual symptoms indicating suppuration.

Treatment.—Theoretically, localised abscesses in the spleen admit of drainage, just as do hepatic abscesses and, if the diagnosis be made, this is the proper treatment. An incision would be made over the most prominent part of the tumour, if possible below the margin of the ribs. Sometimes it might have to be made through an intercostal space. The abscess would then be opened by Hilton's method and efficiently drained. Any free bleeding could be met by plugging.

If an abscess occurs in the spleen and the latter does not become adherent to the abdominal parietes, it must be dealt with like any other non-adherent abscess within the abdomen (see Hepatic Abscess, etc.). In one or two instances the spleen has been extirpated successfully for this condition and splenectomy has also been suggested for cases in which there are numerous abscesses scattered through the organ, but these are usually cases of general pyæmia.

SYPHILIS AND TUBERCULOSIS OF THE SPLEEN.

TUBERCULOSIS OF THE SPLEEN is always a part of tuberculosis elsewhere and does not call for surgical treatment.

SYPHILIS OF THE SPLEEN is very rare and is more interesting from the point of view of diagnosis than of treatment. The latter is that for tertiary syphilis, in which stage the affection of this organ occurs.

HYDATID OF THE SPLEEN.

This affection is well known and several cases have been operated upon. The spleen may be implicated alone or, more usually, in conjunction with the liver or other organs. The cyst makes its way forward towards the abdominal wall and presents the typical hydatid characters (see Hydatid of the Liver) or it makes its way upwards and backwards, contracting adhesions to the diaphragm and eventually opening into the pleura or the lung. As in the case of the liver, aspiration will determine the diagnosis.

TREATMENT.—This resembles that of hydatids elsewhere and consists essentially in opening the cyst with suitable precautions against infection of the peritoneal cavity, evacuating its contents and providing drainage (see Hydatid of the Liver). Splenectomy has been suggested for the affection but incision and drainage seem much more suitable. If the cyst be large, there will be considerable adhesions and an attempt at splenectomy will be accompanied by much shock and bleeding, while drainage is safer, simpler and gives equally good results.

The treatment of a hydatid of the spleen, after it has opened into the thorax, is identical with that of a similar condition in the liver.

TUMOURS OF THE SPLEEN.

These are comparatively rare. They are generally sarcomatous in nature and spring from the capsule of the organ, the rest of the gland being quite

healthy. Adhesions to neighbouring structures soon occur, and entire removal is thus rendered very difficult.

TREATMENT.—This must be splenectomy and, before deciding upon undertaking it, the condition of affairs must be closely examined so as to see that adhesions, especially in the neighbourhood of the stomach and colon, do not render complete removal doubtful; if they do, the operation had better not be undertaken.

HYPERTROPHY OF THE SPLEEN.

This is the chief affection of the organ with which the surgeon is called upon to deal. The enlargement may be due to various causes and the prognosis with regard to the result of splenectomy will vary with the cause.

CAUSES.—The commonest cause of splenic enlargement is malaria, in which the spleen may become enormously hypertrophied and cause the greatest discomfort by its mere size. A similar enlargement may accompany leukæmia, a condition in which there are profound changes in the blood and lymphatic glands. Enlargement also occurs as a result of congestive conditions, such as cirrhosis of the liver or cardiac disease; these two last forms of enlargement are not amenable to surgical treatment. Simple or idiopathic enlargement due to an increase in the glandular tissue is also met with and its cause is unknown. A case is diagnosed as idiopathic when there is an absence of a malarial history, and when there is no leukæmia or any other known cause for the enlargement.

Hypertrophy of the spleen may cause much discomfort and is often associated with ill-health and anæmia apart from any actual leukæmic changes. The value of splenectomy in these cases has been much discussed, and the operation has been done in a large number of cases with very varying results; the results depend to a great extent upon the nature of the primary cause. Thus the great majority of patients suffering from leukæmia die after splenectomy, the cause of death being hæmorrhage. Curiously enough this happens even after the greatest care has been taken to tie every visible bleeding point, and the result of a large number of operations seems to show that the operation is unjustifiable when the enlargement is leukæmic. Quite apart from the large mortality,—something like 90 per cent.,—the operation does not arrest the primary disease. The mortality after splenectomy for malarial enlargement is also considerable, and the operation should not be done unless the patient be suffering severely.

This leaves only the so-called idiopathic enlargement of the spleen as a legitimate object of splenectomy. A considerable number of cases have been done for this condition with success and the operation is quite justifiable provided that the symptoms are severe enough to warrant it. It is called for when there is a very large spleen producing considerable pressure symptoms and impairing the patient's health.

Splenectomy.—The operation is comparatively simple but it must be carried out with the greatest care, particularly in the direction of arresting

all hæmorrhage. Mere oozing points at the time of operation may continue to bleed and eventually lead to the patient's death.

When the mobility of the organ seems to point to an absence of adhesion and the case is one of a large spleen hanging down into the abdomen, the organ is best reached through a vertical incision going through the outer edge of the left rectus. The incision should reach from the costal margin to well below the umbilicus. It must be large enough to allow the spleen to be delivered through it without the least traction. The edges of the incision are retracted and the spleen is examined to see if there be any adhesions; should these be extensive, the operation is contra-indicated because the great danger is the oozing from them which will persist after the wound is closed.

When there seems a good prospect of removing the organ successfully, the spleen is delivered through the wound so that it lies upon the surface of the abdomen, and the remainder of the operation is performed outside the abdominal cavity. In delivering the spleen in this manner the greatest gentleness must be used, as otherwise fatal hæmorrhage may easily occur; if not sufficiently large, the wound must be increased so as to allow of this. In particular, traction upon the pedicle must be avoided, as the splenic vein is friable and readily torn; moreover, traction upon the pedicle may cause profound shock from injury to the sympathetic plexuses. Before the organ is drawn out of the wound, the position of the pedicle must be carefully noted so that, should any accident occur, the surgeon can at once grasp it either between the thumb and forefinger or with a pair of long clamp forceps.

The treatment of the pedicle must be very carefully attended to. If the patient be in good condition and there be no particular hurry, the individual branches of the splenic vessels may be isolated, tied in two places and divided between. In addition, the pedicle should also be tied off in sections by interlocking ligatures and all tension upon the pedicle is relaxed when these are being tied, as otherwise their hold may be insufficient. The number of ligatures will vary according to the breadth of the pedicle. They should be of moderately stout silk and, if the pedicle be not too broad, the whole mass should be surrounded by a final ligature in addition, the first knot of which is drawn tight by an assistant who keeps up traction while the pedicle is divided and ties the second knot when the spleen has been removed and when there is therefore no tension upon the pedicle. In cases of great hypertrophy the pedicle is very broad and the vessels are of enormous size; indeed some of them at first sight look almost like small intestine. The ends of the ligatures around the pedicle should be left long and a pair of Doyen's clamp forceps should be applied to the pedicle between them and the spleen before the latter is removed.

The pedicle is now cut through between the forceps and the ligatures and is carefully examined to see that there is no bleeding, when the ligatures around it may be cut short and the pedicle dropped into the abdomen,

whilst the surgeon turns his attention to the ligament attaching the spleen to the diaphragm. As much care must be taken to control hæmorrhage from this structure as from the pedicle proper, for, although the vessels are not very large, they are numerous, and continued oozing from them might lead to death; any adhesion requiring division must be tied. The spleen is now removed and the whole surface of the wound is exposed and gone over so as to make sure that every bleeding point has been secured by ligature. Mere clamping is not sufficient as, although it may temporarily arrest the bleeding, this is very likely to recur after the abdomen is closed, when the patient begins to vomit on regaining consciousness, and fatal results have been known to occur under these circumstances. The same care must be taken with the abdominal incision, because the coagulating power of the blood is comparatively imperfect in some of these cases even though there be no leukæmic condition.

When the patient is very feeble and time is of great importance, the best plan is to clamp the pedicle and the other attachments of the spleen at once with Doyen's forceps and to cut the organ away rapidly. When this has been done, attention is turned to the vessels behind the clamps, which should be tied, first of all separately and then by a series of interlocking ligatures, care being taken to apply the latter sufficiently far back to obviate any risk of slipping. Care must be taken that there is no traction upon the pedicle as the ligature is tightened.

Should it be found that oozing continues in spite of the greatest care in ligaturing bleeding points, it may be necessary to pack the cavity with gauze, in which case it will be imperative to leave a portion of the abdominal incision open. This however should rarely be necessary because the operation should not be undertaken if the adhesions be bad enough to cause much oozing.

The *after-treatment* is that for laparotomy in general, the abdominal wall being sutured in three layers as usual (see Part VI., Sec. I., p. 189). It may be necessary to employ intra-venous saline infusion when the shock has been considerable or, in cases of splenectomy performed for injury, when the combined shock and loss of blood have rendered the patient very collapsed.

DIVISION III.

THE SURGICAL AFFECTIONS OF THE
GENITO-URINARY ORGANS.

*SECTION I.—AFFECTIONS OF THE KIDNEY
AND URETER.*

CHAPTER XVII.

ANATOMY OF THE KIDNEY AND URETER: METHODS
OF EXAMINATION: CONGENITAL ABNORMALITIES.

ANATOMY OF THE KIDNEY AND URETER.

ANATOMY OF THE KIDNEY.—The following points taken from Henry Morris¹ are of value both in diagnosis and treatment:

“**Surface anatomy.**—The kidney occupies a space which is represented *on the anterior surface* of the body in Fig. 34. A horizontal line through the umbilicus is below the lower edge of each kidney; a vertical line carried upwards to the costal arch from the middle of Poupart's ligament has one-third of the kidney to its outer side, and two-thirds to its inner side: *i.e.* between this line and the median line of the body.

On the posterior surface of the body its boundaries are indicated by the following: (1) A line parallel with and one inch from the spine between the lower edge of the tip of the spinous process of the eleventh dorsal vertebra and the lower edge of the spinous process of the third lumbar vertebra.

¹ *Surgical Diseases of the Kidney and Ureter.* London, 1901. Cassell and Co. From this exhaustive work all the following anatomical facts are taken, many of them *verbatim*, besides many valuable points in the succeeding chapters.

(2) A line from the top of this first line outwards at right angles to it for $2\frac{3}{4}$ inches.

(3) A line from the lower end of the first transversely outwards for $2\frac{3}{4}$ inches.

(4) A line parallel to the first and connecting the outer extremities of the (2) and (3) lines first described (see Fig. 35)."

The upper two-thirds of the normal kidney are under cover of the ribs, but the lower third descends below them.¹ The upper end of the kidney is about a centimetre nearer the spinal column than the lower end. The outer border at its upper part is three and a quarter inches from the middle line, at the lower part three and three-quarter inches. The hilum of the left kidney is two inches from the aorta, and the hilum

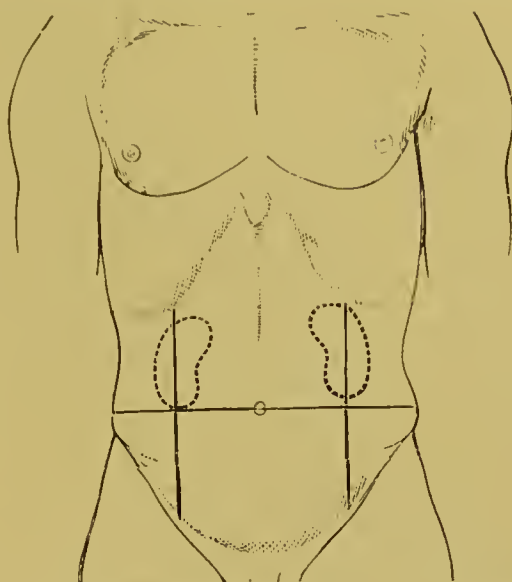


FIG. 34.—THE SURFACE-MARKING OF THE KIDNEY FROM THE FRONT. (*Morris.*)

of the right kidney about one and three-quarter inches from the vena cava. These measurements however may be greatly altered by disease, especially inflammatory affections, owing to the condensation and shrinking of the tissues in the hilum, so that, on the right side especially, the vena cava may be brought quite close to the inner border of the kidney. The right kidney is lower than the left by something like half an inch, but this is not absolutely constant.

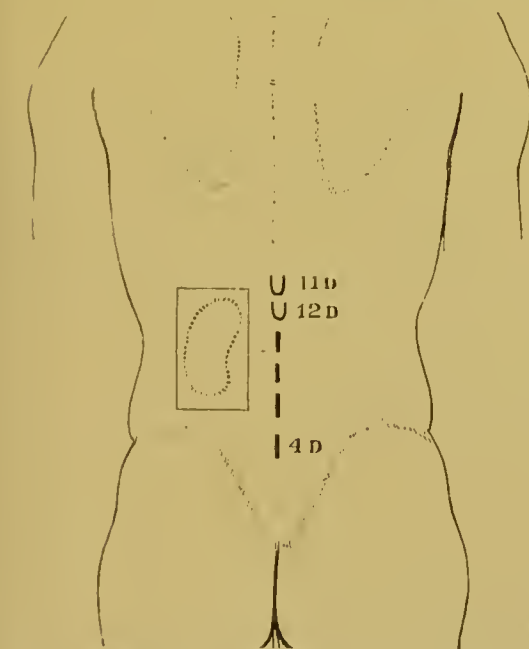


FIG. 35.—THE SURFACE-MARKING OF THE KIDNEY IN THE LOIN. (*Morris.*)

In the hilum of the kidney lie the renal artery, the renal vein, and the ureter, along with lymphatics, which run to the median lumbar glands, and nerves which are derived from the renal plexus and the lesser splanchnic nerve. In the pelvis of the kidney the relation of these structures is,

¹The usual anatomical teaching is that two-thirds of the kidney lie below the ribs. The proportions given above are those usually found in surgical experience.

from above downwards, artery, vein and ureter, while from before backwards it is vein, artery and ureter. The vein runs almost horizontally, and on the right side it is a little lower and shorter than on the left. On the left side it passes in front of the aorta, below the superior mesenteric artery and above the third part of the duodenum. The left renal vein is joined by the left spermatic vein. The artery is large and arises from the side of the aorta a little below the superior mesenteric artery. It divides into three chief branches before it reaches the hilum, and this must be remembered when the pedicle of the kidney is ligatured close to the organ itself. One of these branches runs behind the renal pelvis.

The kidney lies imbedded in a mass of fat, which is called the tunica adiposa; it is especially thick and plentiful posteriorly and upon the convex border of the kidney, but in front it is very thin. It is also thick below the lower end of the kidney, and it is very delicate and of a canary-yellow colour and is only loosely connected with the fibrous capsule of the gland, unless inflammation has occurred. This fat, with the kidney it surrounds, is contained in a fascia, called the peri-nephric fascia, and the surgeon must bear this in mind, as it is apt to be mistaken for peritoneum. This fascia is open along the inner and lower borders of the kidney; hence the mobility of the kidney in the inward and downward direction.

Relations to the peritoneum.—The anterior surface is the only one which comes into any relation with the peritoneum, and is only in contact with it where the other structures, to be mentioned immediately, are not lying on the kidney.

Relations to the supra-renal capsule.—The right supra-renal rests upon the upper pole of the right kidney; the left is in relation with the upper part of the inner border and slightly with the anterior surface and the upper pole. It is separated by areolar tissue from the kidney, but on the left side the left supra-renal vein joins the renal vein, and the relation is more intimate than on the right, where that vein goes direct to the vena cava.

Relations of the anterior surface of the kidney.—On the *right side*, at the upper part, the peritoneum is in contact with the kidney, and in front of it is the under surface of the right lobe of the liver. At the middle towards the left margin the second part of the duodenum overlaps the kidney, and lower down and to the right is the hepatic flexure of the colon. Below, in the angle of the hepatic flexure, is a coil of small intestine. On the *left side* above, the front of the kidney is separated from the fundus of the stomach by the splenic artery. It then comes in contact with the pancreas, and along its outer border it is in relation with the commencement of the descending colon, with a coil of small intestine to the inner side. The outer border of the kidney in its upper two-thirds is in contact with the spleen; in the lower third, with the descending colon. The peritoneum is in contact with it at the upper and lower ends and along the upper part of its left border.

Relations of the posterior surface of the kidney.—Posteriorly the kidney rests upon the diaphragm at the upper part, and below on the anterior layer of the posterior aponeurosis of the transversalis muscle, which separates it from the quadratus lumborum. Internally and inferiorly it rests upon the psoas muscle. The upper edge of the kidney corresponds to the space between the eleventh and twelfth ribs, and the lower edge is nearly on a level with the middle of the third lumbar spine. The ligamentum arcuatum externum is also in relation with the kidney just below the diaphragm, and this ligament may be an obstacle to the removal of the organ, and may require partial division. Running down a little below the middle of the kidney is the last dorsal nerve, and towards the lower part the ilio-hypogastric and the ilio-inguinal nerve, and it is the close relation of these nerves to the kidney that probably explains some of the transferred pains in cases of renal disease.

Lastly, from without inwards the following structures lie between the kidney and the surface in the lumbar region, looked at from behind: skin, superficial fascia, deep fascia, then the aponeurosis, and some fleshy fibres of the latissimus dorsi; beneath the latissimus lie the serratus posticus inferior and the posterior layer of the aponeurosis of the transversalis muscle, and, further out, the fleshy origins of the external and internal oblique muscles, while above are the whole of the twelfth rib except its head, the external intercostal muscle between it and the eleventh rib, and about two inches of the latter near its angle. Internally comes the erector spinæ, beneath and to the outer side of which is the middle layer of the posterior aponeurosis of the transversalis abdominis, and externally to this the fleshy fibres of the transversalis. In front of the quadratus is the anterior layer of the posterior aponeurosis of the transversalis muscle, with the last dorsal, ilio-hypogastric, and ilio-inguinal nerves, and the outer part of the psoas muscle. In front of this again is the peri-nephric fascia, and inside that the adipose tunic of the kidney. In some instances it may be necessary to resect a portion of the last rib in order to obtain space for the removal of the kidney, and care must then be taken not to injure the pleura which descends to the neck of the twelfth rib; further forward the twelfth rib is generally free of the pleura which runs from its neck to the eleventh rib. In some cases however it may even descend below the neck of the twelfth rib. When the last rib is rudimentary the pleura may run from the level of the last dorsal vertebra to the eleventh rib, or in some cases only from the eleventh dorsal vertebra to the eleventh rib.

ANATOMY OF THE URETER.¹—The ureter is about twelve inches in length, varying from ten to fifteen inches, and is slightly longer on the left side than on the right. It commences at the termination of the renal pelvis at a point to the inner side of and somewhat above the lower extremity of the kidney, opposite the body of the second lumbar vertebra. On the posterior surface of the body this corresponds to a point four and a half to five and a

¹ See Morris, *op. cit.*, Vol. II., p. 275 *et seq.*

half centimetres from the middle line on a level with the upper border of the second lumbar spine, while on the anterior surface it is four and a half to five and a half centimetres from the middle line on a line drawn round the body about one inch below the mid-distance between the upper border of the manubrium sterni and the upper border of the symphysis pubis. Another point given to indicate the commencement of the ureter is the intersection of a transverse line between the tips of the twelfth ribs, with a vertical line drawn upwards from the junction of the inner and middle thirds of Poupart's ligament. The ureter descends on the surface of the psoas muscle to the

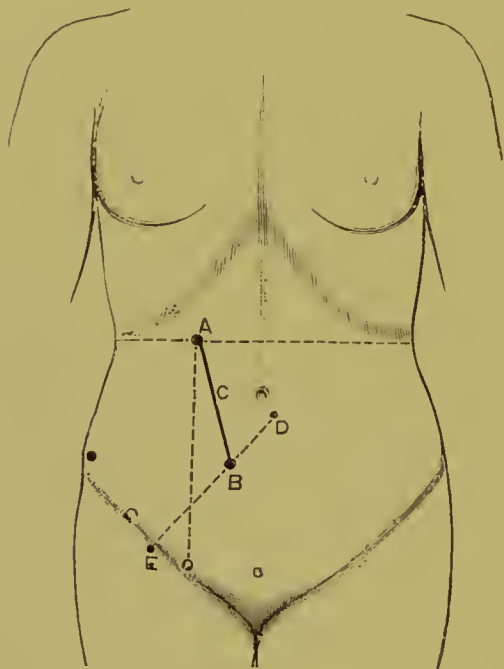


FIG. 36.—THE SURFACE MARKING OF THE ABDOMINAL PORTION OF THE URETER. *A.* Commencement of ureter. *B.* Ureter at pelvic brim. *C.* Line of abdominal portion of ureter. *D.* Bifurcation of aorta. *E.* Mid-point between symphysis and ant. sup. iliac spine. The horizontal dotted line is the level of the tips of the last ribs; the vertical one is drawn upwards from the junction of the inner with the middle third of Poupart's ligament. (*Morris.*)

brim of the pelvis, where it crosses the lower end of the common or the upper part of the external iliac arteries (see Fig. 36). At the brim of the pelvis, the position of the ureter is indicated in front by a point corresponding to the junction of the upper and middle thirds of the line indicating the course of the common and external iliac arteries. This line is drawn from a point half an inch below and to the left of the umbilicus to a point midway between the anterior superior spine of the ilium and the symphysis pubis. It then turns backwards and outwards along the side of the pelvis to a point about an inch in front of the spine of the ischium; thence it passes forwards on the upper surface of the levator ani muscle to its

termination in the wall of the bladder. In its course it presents three constrictions and two intermediate dilatations. The first constriction is situated about two and a half inches below the hilum of the kidney, and this is the narrowest part of the ureter. The second constriction is at the point where it passes over the pelvic brim, and the third is at its termination in the bladder wall.

Relations of the ureter.—The *abdominal portion* lies on the psoas and crosses the genito-crural nerve about half-way between the commencement and the brim of the pelvis. Anteriorly its upper part is in direct contact with the peritoneum and intimately connected with it. In the lower part the spermatic or ovarian arteries pass between the ureter and the peritoneum and are closely connected with both. On the right side

the upper part is covered by the third part of the duodenum, while lower down the right colic and ileo-colic arteries, the terminal part of the ileum and the vermiform appendix pass in front of it. On the left side the ureter is crossed anteriorly by the left colic and the sigmoid branches of the inferior mesenteric artery and by coils of jejunum, while the inner border of the colon may overlap the ureter if the former be distended. Lower down it is crossed by the commencement of the rectum.

The pelvic relations are the most important owing to the depth at which the ureter is situated and the consequent difficulty in getting at it. *In the male*, after crossing the pelvic brim, the ureter passes downwards and backwards along the side wall of the pelvis at a point an inch to an inch and a half in front of the spine of the ischium. It lies immediately in front of the internal iliac artery and externally is in contact with the pelvic fascia covering the obturator internus and it crosses the obliterated hypogastric artery and the obturator vessels and nerve. Internally it is covered by peritoneum which separates it from the sigmoid flexure of the colon on the left and from the terminal portion of the ileum on the right. In the second part of its course in the male pelvis the ureter runs forwards and inwards to the base of the bladder, lying beneath the peritoneum upon the upper surface of the levator ani muscle. It lies against the side and base of the bladder below the level of the obliterated hypogastric artery. Before it reaches the bladder it comes into relation with the vas deferens, which passes between it and the side wall of the bladder, and it enters the bladder wall immediately in front of the upper end of the vesicula seminalis.

In the female the pelvic portion of the ureter may also be looked on as consisting of two parts, an upper and a lower. The upper part passes, as in the male, from the brim of the pelvis downwards and backwards on the lateral wall to a point an inch or an inch and a half in front of the ischial spine. The second part runs forwards and inwards on the upper surface of the levator ani muscle and beneath the base of the broad ligament. It is accompanied by a dense plexus of veins from the lower part of the uterine and the upper part of the vaginal plexuses. It crosses below the uterine artery, crossing the side of the cervix uteri and above and in front of the lateral fornix of the vagina; it enters the base of the bladder in the undistended state at a point three-quarters of an inch from the middle line and a quarter of an inch below the anterior fornix.

In the bladder in both sexes its course is obliquely downwards and inwards for about three-quarters of an inch and the ureter lies nearer the inner than the outer surface of the bladder, the muscular coat being posterior to it throughout nearly its whole length. The vesical orifice is slit-like, with its long axis directed backwards and outwards; it is frequently situated on the summit of a small elevation from three-quarters to one inch distant from its fellow and about the same distance from the orifice of the urethra. Between the orifices an elevation is seen on the inner surface of the bladder formed partly by a band of the longitudinal muscular fibres of the ureter and

partly by the muscular fibres of the bladder. This ridge forms the base of the trigone.

The arteries which supply the ureter are branches of the renal, the spermatic or ovarian and the vesical arteries and they anastomose freely in the wall of the ureter. The lymphatics are numerous, and terminate at the lower part in the iliac and at the upper part in the lumbar glands. The nerves are derived from the renal, the spermatic or ovarian and the vesical plexuses.

EXAMINATION OF THE KIDNEY AND THE URETERS.

EXAMINATION OF THE KIDNEY.—**Inspection** shows nothing except when the kidney is enlarged or when there is peri-nephric inflammation. When the patient lies on his back, a much enlarged kidney may give rise to a prominence in front which becomes more evident during deep expiration, but the organ must be very big before this will occur. In peri-nephric inflammation fixation of the muscles on the affected side during respiration may be evident.

Palpation.—It is very difficult to feel the normal kidney, and at most only the lower end of it comes down between the fingers. When the kidney is being palpated, the patient should lie on his back with the legs drawn up and the shoulders slightly raised, and the left hand should be placed beneath the right loin, and *vice versa*, with its upper border just below the last rib, so that the patient rests well upon it and has the kidney pushed well forward (see Fig. 37). The other hand is spread out flat over the abdomen and presses firmly backwards and upwards under the lower ribs. The manipulations must be very gentle and must be practised with the flat hand, as otherwise the muscles will contract and nothing will be felt. During the examination the patient should in the first instance breathe quietly and subsequently as deeply as possible without contracting the abdominal muscles unduly during the act. The kidney descends during inspiration, and if then it be pushed forward by the hand behind while at the same time the hand in front presses backwards, the organ will be felt if it be enlarged, and any abnormality about the lower end may be detected. Further, if the hand in front be pressed well inwards and upwards during deep inspiration, the entire kidney, if movable, may be caught and fixed below the ribs. This may not be possible at the first attempt but, if the kidney be movable, steady pressure kept up throughout deep respiration will generally end in the organ being caught thus. When the kidney is freely movable, the sign known as “renal ballotement” may be elicited; by thrusting the fingers of the hand behind the loin suddenly against the soft parts the kidney may be driven against the fingers of the hand in front, and *vice versa*. This usually indicates considerable mobility and an absence of adhesions such as would be present in inflammatory affections.

Additional information may often be obtained by altering the position of

the patient. An enlarged mobile kidney may descend and become more noticeable when the patient is in the erect position, and one that is movable but not enlarged may thus be felt more easily. Moreover, by turning the patient over on one side a kidney may be felt which otherwise would escape observation. When the kidney is very movable and the patient is put in the genu-pectoral position, the kidney will fall on to the hand placed over the front of the abdomen. Some information may be gained by eliciting the presence of tenderness, even though there be no enlargement, and sometimes the examination may set up hæmaturia. Unless the result of the examination be thoroughly conclusive, a further investigation should be practised under an anæsthetic before leaving the patient; this thoroughly relaxes the abdominal walls, and is especially valuable when the kidney is tender, the patient timid or the abdominal walls rigid.



FIG. 37.—METHOD OF PALPATING THE KIDNEY.

Percussion is of more value as indicating that a given swelling is situated in the renal region than as determining the condition of the kidney itself. As the colon lies in front of the kidney, a renal enlargement will always give rise to dulness in the flank with the colon resonance in front of it, whereas the dulness due to splenic and other enlargements is likely to be in front of the bowel. There is no resonance between the kidney and the vertebral column.

Cystoscopy.—An important method of examination is inspection of the ureteral orifices either with special specula in the female or with the cystoscope in the male. By these means it may be possible to ascertain whether urine is flowing from both orifices, and also the character of the urine from each; for instance whether blood or pus is coming from one kidney. A good way to ascertain whether both kidneys are functionally active is to inject a cubic centimetre of a 5 % sterilised solution of methyl blue beneath the skin of the buttock and then to watch the flow from each ureteral orifice; the drug gives rise to blue urine within an hour, and this increases in intensity for several hours, and thus not only can the patency of the ureter be determined, but also the

condition of the kidney itself. Both these methods are referred to more fully in connection with affections of the bladder.

Catheterisation of the ureters.—This procedure is employed in order to determine the character of the urine coming from each side, but it is very difficult to carry out in the male although not so difficult in the female : it is open to the objection that by it infection may be carried up to the pelvis of the kidneys. The method is theoretically a very fascinating one but it requires great patience and considerable skill even in the female, and is hardly likely to come into general use. Those interested in the subject would do well to consult Kelly's and Morris's works.¹

The X-rays have been employed extensively and with some success in demonstrating different forms of stone (see Chap. XXII.).

Exploratory incision.—In some cases this may be practised with advantage, but it should not be done unless there be reason to believe that benefit will ensue ; it is usually reserved for cases where the presence of a stone in the renal pelvis is suspected. Occasionally no stone is found and there is nothing abnormal to the naked eye, and yet the pain and neuralgia from which the patient suffers disappear after the exploration.

The question of an exploratory incision may arise in cases of tuberculous kidney when there is a question of doing nephrectomy. One of the chief arguments advanced in favour of nephrectomy by the abdominal as opposed to the lumbar route is that in the former the hand may be introduced into the abdominal cavity and the condition of the opposite kidney ascertained. Valuable information may no doubt be obtained in this way, but it has reference rather to the question of the existence of another kidney than to its actual condition, for it must be remembered that, when one kidney is disorganised, its fellow may be enlarged from compensatory hypertrophy and may easily give to the hand the impression that it is diseased. Undoubtedly, if the kidney be nodular from the presence of abscesses, or if a stone be felt in the pelvis, or if the organ be atrophied or absent, this may be made out by palpation through the abdomen and the information is valuable. On the whole, however, the method is unreliable and indeed, if it be essential that the condition of the opposite kidney should be ascertained, the only sure way of gaining certain information is to cut down upon each kidney in the loin in succession. In the first place the kidney supposed to be healthy should be exposed, its fatty capsule opened and the organ palpated or even inspected, after which, examination of the kidney supposed to be diseased may be proceeded with if the condition of the first be favourable. Mere incision of the loin for exposure of the kidney is not a very severe operation and is much more satisfactory in its results than any other plan. It is, however, only in a comparatively few cases that such a procedure will be called for. Generally the condition of the kidney may be sufficiently ascertained by palpation and other means of investigation and as a rule the affected kidney is usually so

¹ H. A. Kelly, *Operative Gynecology*, Kimpton, London, 1899. Henry Morris, *op. cit.* See also Affections of the Bladder.

disorganised when nephrectomy is absolutely called for that its fellow must be active or the patient would not be alive.

Examination of the urine often gives much information both as to whether the seat of disease is the kidney or the bladder, and as to which kidney is affected.

Hæmaturia.—When of renal origin the blood is usually intimately mixed with the urine and varies in colour from a smoky tint to a deep porter-like brown. In rupture of the kidney, however, and in cases of growth where blood is poured out in large quantities the tint may be much brighter, but here there is an important sign of renal hæmaturia in the presence of clots which take the form of the calices or pelvis of the kidney or of the ureter frequently also the expulsion of these clots is accompanied by renal colic.

Free hæmaturia of spontaneous origin is most likely to be due to a renal growth. When it only occurs after exertion and is moderate in quantity it may be due to a calculus. In renal tuberculosis on the other hand the hæmaturia is generally slight, does not depend on exertion and is generally accompanied by a considerable amount of pus.

The diagnosis between hæmorrhage from the bladder and that from the kidney is further facilitated by washing out the bladder; when the blood comes from the kidney, the last fluid which is thus obtained will be clear and will remain so until fresh blood comes down the ureter. When however the hæmorrhage comes from the bladder it will be practically impossible to render the fluid quite free from the admixture of blood, however frequently the washing be repeated. The cystoscope will also be of value in hæmaturia of renal origin after the bloody urine has been thoroughly washed out of the bladder, whereas in hæmaturia of bladder origin it is difficult to render the fluid in the bladder clear enough for a distinct view to be obtained. Further information will be obtained by microscopical examination, from the presence of pieces of tumour, of renal casts, of parasites, such as distoma hæmatobium, hooklets, etc.

Pyuria.—When pus is present in the urine it is difficult to be sure that it is of renal origin unless other clinical symptoms point to the kidney as its source. Of course, the presence of renal epithelium will aid the diagnosis, and important information may be obtained from cystoscopic examination, as the bladder may be found free from inflammation and the pus may be seen coming from the ureter in a thick muddy stream; on the other hand, the urinary stream may be clear and there may be found some bladder lesion accounting for the presence of the pus.

Determination of the side affected.—In many cases there is no difficulty in coming to a proper conclusion as to the particular kidney involved; in others there may be considerable doubt. The following points are of use: Pain, especially the characteristic kidney pain, shooting down the ureter and into the groin, when constant and referred to one side only, practically points to that side as the seat of disease. It is stated that pain may be referred to the side opposite to that on which the kidney is affected,

but it is very doubtful whether the whole pain of the patient is ever so referred, and indeed whether pain is really present without that side being also diseased. Further evidence is obtained by palpation of the kidney; in some cases the presence of an increased amount of pus or blood in the bladder after palpation of a particular kidney may indicate which side is diseased. In cases of doubt, examination of the ureters and their orifices may be of help; by it one may see whether there is a difference on the two sides, in the way for example of enlargement or swelling or of a difference in the stream of urine issuing from each. Catheterisation of the ureter (see p. 170) may lead to valuable information in the female.

EXAMINATION OF THE URETERS.—The condition of the ureters may be made out by palpation, by inspection of their orifices, or by catheterisation.

Palpation of the ureters may be effected through the abdominal, the vaginal, the rectal, or the vesical walls. Through the abdomen the ureter can only be felt when the patient is thin and has lax abdominal walls, and then only if the tube be thickened or contains a foreign body. Only that part of it extending from the pelvis of the kidney to the brim of the true pelvis can be felt in this way. The surface-marking of this portion has already been given (see p. 166). The patient should be in the same position as for palpation of the kidney (see p. 168), and it is best to make the examination under an anæsthetic.

In the female the ureter is best felt by palpation through the antero-lateral fornix of the vagina and the terminal two-and-a-half inches of the ureter may here be felt if it be thickened, dilated, or contain a foreign body. It runs forwards about midway between the cervix uteri and the wall of the pelvis. The uterine artery or the muscular fibres of the levator ani or obturator internus must not be mistaken for the ureter. In the female also the lower end of the ureter may be felt by palpation from the bladder after the urethra has been fully dilated and a bi-manual examination with one finger in the bladder and another in the vagina will readily ascertain the presence of a stone impacted in the lower end.

In the male, the lower end of the ureter, if it contain a foreign body, may be felt through the rectum, but not nearly so easily as it is felt through the vagina in the female. It is situated a little higher up than the level of the base of the vesiculæ seminales, and in many patients this is a point that it is extremely difficult to reach by digital examination of the rectum however well the bladder be pushed downwards. In the male, palpation of the ureter through the bladder is of course only possible after a cystotomy, either supra-pubic or median, which would not, as a rule, be done for mere examination purposes.

The use of the cystoscope or endoscope for inspecting the vesical orifice of the ureter has already been discussed (see p. 169). The employment of ureteral catheters for withdrawing urine from each ureter separately, or for

dilating a stricture of the tube, has already been mentioned (see p. 170), and will be referred to later in connection with the affections of the bladder; practically they afford very little information which cannot be obtained in other ways and with decidedly less risk and inconvenience.

CONGENITAL ABNORMALITIES OF THE KIDNEY AND URETER.

Abnormalities of the kidney are of little interest from the point of view of treatment. As they may be met with during operations however and may puzzle the operator, some of the chief ones may be enumerated. The two kidneys may be fused together to form the "*horse-shoe kidney*," which is usually situated unduly low down, more commonly over the sacro-iliac synchondrosis, the promontory of the sacrum or even lower in the pelvis; according to Morris this condition is said to occur once in about every thousand bodies. *Displacements* of one kidney or of both may also occur and the kidney may vary in form or size and may be markedly lobulated. There may be only *a single kidney* present and according to Morris this occurs once in every 2400 bodies.

Congenital cystic disease of the kidney is usually bi-lateral and is not amenable to treatment. *Supplementary kidneys* are extremely rare, but we have met with an example of a third kidney¹ which gave much discomfort and from its situation was supposed to be an omental tumour; an exploratory laparotomy was therefore performed.

Abnormalities of the ureter seldom require treatment. The hilum may be absent, the renal pelvis may be double, the ureter may be double at its upper part—though rarely throughout its whole length—or it may terminate in the urethra, the seminal vesicles, the vagina or even the rectum. Congenital prolapse of the lower end of the ureter into the bladder is also met with; it may also be acquired as the result of stenosis of the ureteral orifice. The ureter may be compressed by an abnormal renal artery, or congenital strictures may occur in it; these may be accompanied by hydronephrosis or atrophy of the kidney.

¹See *Lancet*, 1899, Vol. 1., p. 215.

CHAPTER XVIII.

MOVABLE AND FLOATING KIDNEY.

Movable kidney is the term applied to cases in which the undue mobility is moderate in amount and occurs in the upward and downward direction behind the peritoneum; while the term **Floating kidney** is used to denote a kidney that is extremely movable and can be easily pushed all over its own side of the abdomen. The normal kidney is somewhat movable in the vertical direction, but when the range of movement exceeds an inch and a half abnormal mobility may be said to exist.

Floating kidney may be of either congenital or acquired origin. In some very rare cases there is an exceptionally long renal pedicle, and this and the kidney are completely surrounded by peritoneum, so that there is a distinct mesonephron; in the great majority of cases, even of floating kidney, there is no true mesonephron, although the pedicle becomes elongated and the peritoneum also invests the kidney more completely than usual.

ETIOLOGY.—The affection is something like six times more common in women than in men. The right kidney is more frequently affected than the left and this has been explained by saying that one of the agents in retaining the right kidney in position is the lower edge of the liver, and that the kidney is pressed downwards as a result of tight lacing or a sudden strain and, so to speak, dislocated from under the edge of the liver and does not return to its proper position. Associated with the development of movable kidney is often found general emaciation, with consequent absorption of the adipose capsule of the kidney, and those who hold that the fatty capsule is one of the chief agents in keeping the kidney in position look upon this absorption as one of the chief reasons of the undue mobility. Mobility of the kidney may follow pregnancy, partly from the distension of the abdomen and the subsequent laxity of its walls and possibly partly as a result of violent contractions during delivery. In many instances, no doubt, the immediate cause of the mobility, or at any rate of the patient noticing it, is some injury, such as a blow, a kick or a violent exertion, *e.g.*, jumping, in which it may be assumed that some dislocation of the kidney has occurred.

The mobility of the kidney may occur alone or it may be associated with other troubles, and this point is most important when deciding upon the proper line of treatment. It is not uncommon to find that other organs, especially the stomach and intestines, also descend to an abnormal degree in these cases,—the condition known as *enteroptosis*,—and in some cases also the liver may be unduly movable. The association of movable kidney with enteroptosis is of great importance because many of the symptoms may then be due rather to the condition of the general abdominal contents than to the mobility of the kidney and an operation which merely fixes the latter may in no way relieve them. The frequency with which these conditions are associated is variously estimated by different writers; Glénard, who described this condition of intestinal enteroptosis,—to which indeed the name of “Glénard’s disease” has been given,—holds that practically all cases of mobility of the kidney are associated with it. Other authors on the contrary take quite a different view and, while admitting the occasional association of the two conditions, do not look upon them as being in any way necessarily combined. We must confess that in our experience the two affections are frequently associated, and we regard the recognition of this fact as of the greatest importance in treatment.

PATHOLOGICAL CHANGES.—In considering the question of treatment the changes in the organ resulting from the undue mobility must be remembered. In many cases a movable or even a floating kidney is healthy, but, as the result of the undue mobility, changes may take place which seriously damage the organ. Perhaps the most important of these is the condition of intermittent hydronephrosis. In consequence of the undue mobility the ureter becomes bent or curved, especially in the downward form of displacement, and the result may be more or less complete kinking of the ureter with obstruction to the escape of urine and consequent distension of the pelvis and calices of the kidney; this distension is intermittent, considerable intervals elapsing between the attacks. In other cases there may be a twisting of the renal pedicle which interferes either with the arterial supply or with the venous return. These circulatory troubles damage the kidney, and hæmaturia may occur when the venous return is interfered with. Again, a movable kidney is just as liable to disease as a healthy one, and possibly even more so to cancer. So that we may have to deal with a kidney which is fairly healthy, with one which is the seat of intermittent hydronephrosis, with one in which there are disturbances in the circulation, or with one which is the subject of some disease common to kidneys of normal mobility.

SYMPTOMS.—Symptoms are often entirely absent in movable kidney, and the condition may only be discovered by the surgeon while examining the patient for something else. When however this condition is once discovered, it is remarkable how frequently symptoms arise, and a very striking point is the frequent association of this condition with a general neurotic tendency. So long as the patient does not know that the kidney is movable,

—and the surgeon should never inform her if he discover it accidentally,—there may be no trouble, but, when once the patient knows, she is very apt to exaggerate the discomfort and to develop general hysteria.

In other cases however, movable and floating kidneys give rise to very distinct symptoms. Those associated with mobility of the kidney alone consist essentially in pain of a more or less aching character, with dragging and a feeling of weight in the loin. Gastro-intestinal disturbances, such as nausea or actual vomiting, constipation, flatulence and a general dyspeptic condition are common. Actual dilatation of the stomach may occur and has been attributed to pressure on the duodenum. In some cases gastric crises,—spoken of as Dietl's crises,—are met with; they consist of violent attacks of colic associated with nausea and vomiting and often accompanied by abdominal distension and tenderness and sometimes by a rise of temperature and signs of collapse. Among other symptoms are occasional attacks of jaundice.

In addition to these general symptoms there are those especially associated with the kidney itself, such as intermittent hydronephrosis, renal colic, the appearance of a tumour in the loin, hæmaturia or polyuria; the symptoms may vividly suggest renal calculus. All the symptoms must not be put down to pure hysteria, and also it must be remembered that a good many of the symptoms, especially the dragging pain in the loin, may be due to general enteroptosis and not to the mere mobility of the kidney.

TREATMENT.—The chief points in considering the question of treatment, and especially that of operation, are the association of the kidney trouble with enteroptosis, or with hysteria, and the presence of complications, such as intermittent hydronephrosis or hæmaturia, and lastly the question whether there is any disease of the mobile kidney or not.

(a) **Palliative.**—The symptoms are often slight and do not call for special treatment and it is always well to see what can be done by other means before adopting operative measures.

In treatment without operation the following points must be aimed at:—
1. To improve the patient's general condition and to increase the fat. 2. To enable the abdominal muscles to give proper support to the abdominal contents. 3. To support the abdominal organs by a suitable abdominal belt. 4. To cure any anæmia or neurasthenia, to regulate the bowels and to prohibit over-exertion.

In the first place a modified Weir Mitchell treatment will be of benefit. The patient is confined to bed for three or four weeks and has daily massage,—with special attention to the lumbar and abdominal muscles,—much as in an ordinary neurasthenia case. A certain amount of overfeeding should be practised, and large quantities of milk may be ordered with advantage. Cod-liver oil is useful, and should be combined with iron, if there be anæmia. The bowels should be properly regulated.

In addition to this, and more especially when the patient gets up again, an abdominal belt is very useful. It should aim at supporting the entire

abdomen, and it should be shaped so as to lift the lower part and to give a uniform support all over. The pad over the affected kidney that is sometimes ordered instead of a belt is quite useless, because of the difficulty of employing sufficient pressure below the kidney to keep it up. If the kidney be very movable, a soft air-pad may be fixed to the belt on the affected side, the centre of the pad being about the level of the highest point of the crest of the ilium. This pad, however, is quite of secondary importance, and the essential point is to provide a support to the whole abdomen. The belt must always be worn when the patient is about, and for the first few weeks, while the abdomen is very lax, it may be advisable to wear it in bed as well. Tight-lacing must be interdicted as well as over-exertion of any kind, especially violent strains or any exertion that will produce sudden deep descent of the diaphragm. At the same time, change of scene and avoidance of worry should be secured if possible. If treatment of this kind, carried out for a considerable time, improves the patient's condition very much, it is quite clear that operative interference is unnecessary; further, if the application of the support without any other treatment gives relief to the patient, it may be assumed that nephropexy will not be of much avail, because the fact that the general support relieves the patient implies that the symptoms are due as much to enteroptosis as to the movable kidney, and nephropexy will not affect the former condition. The patient will sometimes give a hint as to whether support will be successful by volunteering the fact that tightening the stays relieves the dragging pain.

(b) **Operative.**—Operative interference will therefore only be called for :
 (a) When the measures above suggested fail to relieve the patient, and the pain is quite definitely referred to the kidney. (b) When the patient suffers from repeated attacks of renal colic; these may occasionally be so frequent and severe as to render life miserable. (c) When there are signs of intermittent hydronephrosis or interference with the circulation through the hilum. These two conditions may occur separately or together, and the latter is generally indicated by hæmaturia. (d) When there is evidence of disease, such as the presence of stone, in a movable kidney.

The treatment of intermittent hydronephrosis from kinking of the ureter will be more appropriately considered in connection with hydronephrosis in general (see Chap. XXIII.). We shall therefore only deal here with the treatment of cases not benefited by support, rest, etc., with those of vascular disturbance, indicated by pain, enlargement of the kidney and hæmaturia, and with those in which there is evidence of disease in the mobile kidney. In all these cases, it is necessary first to expose the kidney, and then, in the first two classes, to fix it properly in the lumbar region, whilst in the remaining set of cases the disease present requires to be suitably treated; afterwards, if possible, the kidney is fixed.

Operative interference takes the form of nephrorraphy or nephropexy, an operation of great value in suitable cases, although some surgeons object to it altogether. The reasons given for this opposition are two: in the first

place it is said not to do good, and in the second it is said that a kidney that has been stitched is apt to become loose again before very long, and the symptoms therefore are likely to recur. The answer to the first objection is, that, although operation fails to benefit all the cases for which it is done, it is undoubtedly of the highest value in cases for which it is really suited. The second objection—namely, the recurrence of the mischief—can be met by suitable operative tactics, and in the great majority of cases it seems to us that there is no difficulty in fixing the kidney firmly and permanently in position. The risks of the operation are practically *nil*, as the only one is that of sepsis. Necrosis of portions of the kidney, urinary fistula, etc., have

been mentioned as possible risks of the operation, but we have no experience at all of such accidents.



FIG 38.—INCISIONS FOR NEPHROPEXY. These are the two incisions described in the text. On the right side is the usual oblique one below and parallel to the last rib; on the left is the more vertical one.

Nephropexy.—The patient should lie upon the sound side, whilst a firm bolster of horsehair or a large sandbag is placed under the loin, so as to open out the interval between the crest of the ilium and the ribs upon the affected side as much as possible. The kidney is best reached by a lumbar incision (see Fig. 38), which is made parallel to the last rib and about a finger's breadth below it, extending from just inside the outer margin of the erector spinae outwards and downwards for about four inches. Another incision frequently used for this particular operation, and one that gives good exposure of the kidney, is an almost vertical one, commencing above over the centre of the twelfth rib and running downwards and a very little forwards to

just above the iliac crest. In the former of these the latissimus dorsi is divided throughout the whole length of the wound and then the incision is steadily deepened from the margin of the erector spinae, the posterior edge of the external oblique being nicked and its fibres separated with the fingers and then the internal oblique and transversalis are similarly separated. Deeper still, the transversalis fascia is divided. After the division of the latissimus dorsi it is best to do as much of the operation as possible by separating the muscles in the direction of their fibres rather than by cutting them across, as a hernia is much less liable to follow this method. Moreover, the deeper parts of the incision need not be opened up to the same extent as the skin wound, as these structures are very elastic, and it is possible to get the kidney protruded through a comparatively small opening in the abdominal wall if the retraction be efficient.

After the transversalis fascia has been divided, the fatty capsule of the

kidney, enclosed in the peri-nephric fascia, is exposed and usually bulges through the opening in the transversalis fascia directly it is made. Occasionally the quadratus lumborum may be unusually broad and its anterior margin requires nicking, but this is very uncommon. When the fatty capsule has been well exposed, it is advisable for the assistant to press the closed fist well up against the anterior abdominal wall just to the affected side of the spinal column so as to push the kidney and its capsule upwards into the wound. A broad retractor (see Fig. 39) is made to pull the transversalis fascia, carrying with it the peritoneum and the colon, well forwards, and the peri-nephric fascia is picked up in two pairs of forceps and opened, when the canary-coloured fat around the kidney at once becomes evident. The true kidney capsule is now cleanly exposed, and as much of the peri-nephric fat is stripped off it as possible, so that eventually none of it shall intervene between the surface of the kidney and the transversalis fascia when the two are brought in contact by sutures. In a healthy kidney the detachment of the peri-nephric fat is quite easy and should be carried far enough to enable the organ to be pulled well out of the wound, which should always be done, not merely to see that the posterior surface of the kidney is thoroughly cleared and to make out exactly the most suitable spot for the insertion of the stitches, but to enable the surgeon to examine the organ and the ureter in order to be sure that no disease is present and that there is no kink, stricture or faulty attachment of the ureter to the pelvis of the kidney. In protruding a very movable kidney, care must be taken not to twist the renal pedicle upon itself and not to mistake the upper end for the lower when returning the organ into position in the loin. Such a mistake should not happen with the exercise of the most ordinary care.

Up to this point all the operations for nephropexy practically agree, the variations in the operation lying mainly in the special measures taken subsequently to fix the kidney in place. This question may be subdivided into two headings: the best method of obtaining adhesion between the kidney and the abdominal wall, and the material that should be employed for the purpose.

As regards the best method of obtaining sound union, the main controversy turns upon the question of whether the true capsule of the kidney should be partially stripped off and the bared renal substance brought into contact with the abdominal wall (decortication) or whether sufficient adhesion can be obtained without the kidney being decorticated. In the majority of operations practised at the present time decortication in some form is the rule.

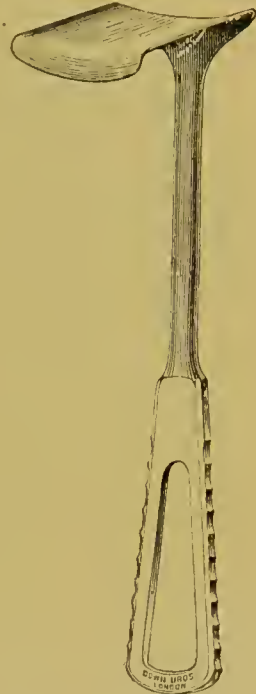


FIG. 39.—RETRACTOR FOR OPERATIONS UPON THE KIDNEY.

At the same time adhesion apparently occurs quite well between the bared fibrous capsule and the abdominal wall and there is nothing in the structure of the former that should prevent it becoming adherent. We have had experience of both methods and with both of them adhesion may be readily and satisfactorily obtained. Another point in which the technique varies is in the method of attaching the kidney to the abdominal wall. In all cases some suture material is employed and in the majority these are carried through the substance of the muscles and tied more or less subcutaneously

rather than through the transversalis alone. The former plan has great advantages, in that it makes it easy to pull up the kidney sufficiently high to fasten it properly in place, whereas if it be merely sutured to the transversalis it is difficult to work in under the ribs and therefore the organ will probably be fastened unduly low down.

Various materials are employed for fastening the kidney, some surgeons using silk whilst others employ catgut, especially for the cases in which decortication has been practised. In Vulliet's operation, which is highly recommended by some, a slip of the longissimus dorsi tendon is detached,¹ passed through the abdominal wall and made to under-run the fibrous capsule of the kidney, its end

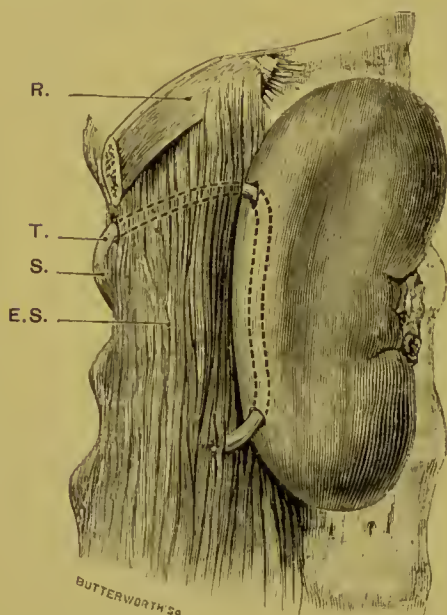


FIG. 40.—VULLIET'S METHOD OF NEPHROPEXY. The figure makes the tendinous suture appear on the anterior surface of the kidney, whereas it should be entirely posterior.

R. Last rib.	T. Tendinous slip.
S. First lumbar spine.	E.S. Erector spinæ.

(Morris, after Vulliet.)

being brought out below and stitched to the erector spinæ (see Fig. 40). This operation is somewhat troublesome and we do not think it is more successful than other and simpler plans.

The various methods of performing nephropexy will be found in detail in Morris's work and we shall only describe here the methods which we ourselves employ.

If *suturing without decortication* be employed, the stitches should be passed through the posterior surface of the kidney and not merely the convex border; a good breadth of the posterior surface should be taken up,

¹Through a separate vertical incision down to the muscle which is made close beside the spine of the first lumbar vertebra for about $2\frac{1}{2}$ inches. The slip of tendon requires to be as long as possible and should be detached at its upper end only. It is threaded on a large-eyed needle or a stout probe and, after under-running the capsule, the free end of the tendinous slip is buried in and sutured to the erector spinæ.

the suture emerging near the convex border. One or two stitches may be used for the upper pole of the organ; in the former case the capsule is perforated, say by a blunt Macewen's needle, about half-way down the inner border not too close to the hilum and then made to under-run the fibrous capsule emerging again just internal to the convex border. One end of the silk is again threaded into the needle and passed through the transversalis fascia

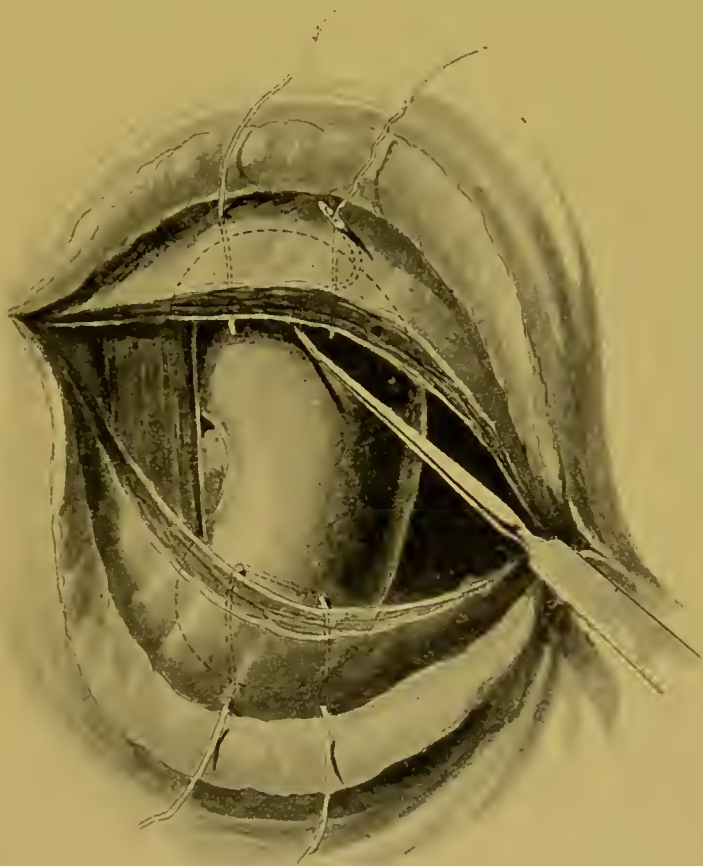


FIG. 41.—NEPHROPEXY WITHOUT DECORTICATION. The illustration shows the method of passing the sutures through the wall of the loin after they have been inserted through the renal capsule and the kidney returned into place. Two sutures are used here, the ends of the upper one being made to emerge from the wall of the loin as close as possible beneath the twelfth rib. The figure shows how to pass the sutures so as to allow the cut edges of the muscles to be approximated without undue tension on the renal stitches.

from before backwards as high up as possible beneath the last rib, being made to emerge through the lumbar muscles just below the bone. The other end of the silk is then passed in a similar manner at a suitable distance from the first, and when the two ends are tied together they will pull up and fix the upper end of the kidney in its normal position. A second suture is passed through the lower end of the organ and carried through the abdominal muscles just below the line of incision, and when tied will fix the lower end of the kidney (see Fig. 41). These sutures however should not be tied until the lumbar muscles have been sutured, otherwise there may either be difficulty in bringing together the divided muscles or else, when this is done,

the kidney may be injuriously pulled upon owing to undue approximation of the sutures. In a large kidney two stitches may be inserted in the upper and more important pole of the organ, but in a vertical instead of a horizontal direction; one suffices for the lower pole (see Fig. 42). All the stitches are tied after the kidney has been returned into the abdomen. The stitches are first of all inserted into the kidney while it is protruded through the wound. The organ is then returned into its place and the ends of the sutures are passed through the lumbar muscles, but are not finally tied until the cut edges of the latter have been approximated.

The assistant keeps the kidney firmly pressed in place, and all the peri-nephric fat is pushed away from between the opposing surfaces of the kidney and the transversalis fascia, while mattress sutures are passed through the cut edges of the lumbar muscles in the usual manner. Before these are tied, the pillow is removed from beneath the loin, and the assistant pulls the kidney up against the abdominal wall by traction on the sutures so as to prevent the protrusion of fat again. After the stitches uniting the edges of the lumbar muscles have been tied, the sutures holding the kidney are fastened just tight enough to secure the organ in position; if tied too tightly pain may be caused. By proceeding thus the abdominal wall is repaired before the kidney is attached to it, and a more satisfactory

FIG. 42.—METHOD OF INSERTING THREE SUTURES IN THE KIDNEY IN NEPHROPEXY. None of the sutures must approach the renal pelvis.

surface is obtained for adhesion. The sutures are cut short, and the skin is united without a drainage tube.

If the kidney is to be fixed after decortication, the following is the method that we are accustomed to employ. Many different ways have been suggested, most of which will be found in Morris's work; nearly all of them are modifications of Tuffier's original plan. After the kidney has been brought up into the loin, a crucial incision is made just through the capsule on its posterior surface (see Fig. 43, *A*). This must not go at all deeply into the renal cortex as otherwise troublesome oozing may occur. The crucial incision divides the capsule on the posterior aspect of the kidney into four triangles, and the apex of each is seized in turn with a pair of forceps, the handle of the knife insinuated beneath it, and the triangular portion of capsule is raised from the cortex as far as the borders of the organ (see Fig. 43, *B*). Through these flaps are inserted sutures of medium-sized catgut in the manner indicated in Fig. 43, *C*. By this means a firm hold is obtained, and there is no risk of the stitches pulling out or the capsule tearing through.

The kidney is now returned into the loin and pushed into its proper place by an assistant. It will then be seen at what spot the catgut stitches must be carried through the lumbar wall in order to anchor the kidney in this situation. It is most important for the proper success of the operation to put the kidney back in place before passing the sutures through the lumbar wall, as otherwise there is a risk of fixing it too low down. The sutures are introduced on a blunt Macewen's needle. Those on the outer pair of flaps, corresponding to the convex border of the kidney, are passed first, and, when they are in position, their ends should be clamped in forceps, but not tied, and it can easily be seen where the inner pair of sutures require to go. As in the operation above described, the lumbar wall is repaired

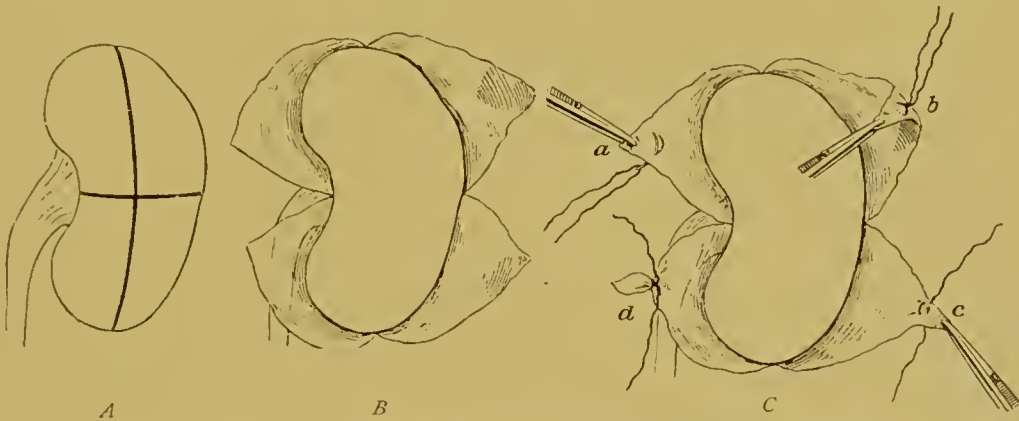


FIG. 43.—NEPHROPEXY WITH DECORTICATION. The various stages are shown, first the crucial incision through the capsule on the posterior surface of the kidney, then the four flaps raised, and finally the four stages, *a*, *b*, *c*, and *d*, of securing the apices of the triangular flaps with catgut sutures which are afterwards passed through the abdominal wall. The suture is first passed through the flap as shown in *a*, and tied as in *b*, then it is brought round again as in *c*, and finally tied as in *d*. The suture thus cannot slip or pull out.

before the stitches in the kidney are tied, and, while this is being done, the assistant keeps the organ pressed up against the loin by pressure through the anterior abdominal wall in the usual way. We have never found any need to use more than the four sutures here described, although some surgeons employ a large number. In this method the whole posterior surface of the kidney is entirely bared of capsule, and should obtain a very firm adhesion to the lumbar parietes. The bleeding is never troublesome, and easily stops when the organ is pressed against the transversalis fascia. Stripping up of the capsule is quite easy, and may be largely carried out by sweeping the finger between the kidney and its capsule after the apex of the triangle has been raised. No drainage tube is required.

After-treatment.—The dressing need not be changed for two or three weeks, when the wound should have healed. The patient should be kept in bed for at least six weeks, so as to allow of firm adhesion of the kidney. A well-fitted abdominal belt is then applied, and for another six weeks the semi-recumbent position is adopted, the patient being allowed to recline on the affected side. During the period of semi-recumbency, over-feeding should

be practised, as well as massage and Faradism, in order to strengthen the abdominal muscles, and the bowels must be carefully regulated. The abdominal belt should be worn for at least six months; if the patient finds it comfortable it may be worn for a long period. In the course of three or four months gentle exercise may be allowed. Six months however should be allowed to elapse before the patient is allowed to consider herself perfectly well and able to do things like other people. It is exceptional for the kidney to become unduly movable after this operation; should it do so, it is doubtful whether a second operation will succeed any better, although it has done so in some cases.

Nephrectomy.—Should the kidney again become mobile and give rise to severe symptoms, the question of nephrectomy will arise. This is very seldom justifiable for simple movable kidney, as, if nephropexy fails, nephrectomy is very apt to prove futile also unless the real source of the trouble be due to some disease in the kidney or to intermittent hydronephrosis. It may however be indicated when the pain is intense and almost exclusively renal in character, as indicated by colic, hæmaturia, or enlargement, of the organ.

If the mobile kidney be diseased, the affected organ must be treated on the lines laid down for the particular condition, and, if this do not involve removal of the organ, the kidney must also be fixed in position afterwards (*vide supra*). The condition of intermittent hydronephrosis is dealt with separately (see Chap. XXIII.).

CHAPTER XIX.

TRAUMATIC AFFECTIONS OF THE KIDNEY AND URETER.

INJURIES OF THE KIDNEY.

THE kidney may be injured with or without an external wound. The latter group of cases is the more important from the point of view of treatment.

SUBCUTANEOUS LACERATIONS.

Injuries to the kidney are most often due to crushes or blows on the abdomen or the loin ; they may follow violent lateral flexion of the trunk, and are frequently caused by or associated with fracture of the eleventh or twelfth ribs. They are often complicated with other visceral lesions, such as a fracture of the spine, the ribs or the pelvis, or rupture of the diaphragm, the liver, the spleen, or the duodenum, and this question must be investigated before deciding on the treatment. The most important point as regards treatment is whether the peritoneum over the kidney has been torn, because if so blood and urine will escape into the peritoneal cavity and very seriously complicate the case.

The degree of injury to the kidney varies greatly. It may be limited to hæmorrhage beneath the capsule ; there may be extensive laceration of the renal substance, tearing of the renal pelvis, injury to the renal vessels, or complete pulping-up of the organ. From the point of view of treatment, the following classification is perhaps the most useful :

1. Injury to the peri-renal capsule alone, without damage to the true capsule of the kidney or the renal tissue.
 2. Bruises of the kidney proper, without rupture of the capsule.
 3. Rupture of the kidney, and its proper capsule not extending into the pelvis.
 4. Extensive rupture of the kidney substance running into the pelvis.
- These are the ordinary severe cases met with in practice.
5. Extreme damage, the organ being broken up into fragments or entirely pulped up.
 6. Laceration of the pelvis or the ureter alone.

SYMPTOMS.—The symptoms vary according to the nature and degree of the injury ; unless this be limited to the peri-nephric tissues there are certain symptoms common to abdominal injuries in general, and others special to the injury of the kidney. The symptoms common to abdominal injuries are mainly those of collapse, varying according to the extent of the injury, but generally profound and lasting a variable time from an hour up to some days ; its severity is complicated by the question of hæmorrhage. It is generally accompanied by vomiting, which in bad cases may be so severe as to be almost uncontrollable, while in milder cases it may only occur once or twice, but is easily excited. Very rarely the patient has a period of unconsciousness ; there is pain in the renal region or diffused over the abdomen.

The special symptoms are due to the escape of blood along the ureter, into the tissues around the kidney or into the peritoneal cavity, and this may be so profuse that the patient presents all the signs of internal hæmorrhage (see Part I., p. 135). The amount and situation of the bleeding are most important indications of the nature and the degree of the injury.

When the kidney itself has escaped serious bruising, there will be, in addition to a feeling of sickness and some collapse, merely tenderness in the loin, without any tumour and without hæmaturia. In all other cases hæmaturia is present, and in addition there will be a tumour in the loin if there be extensive peri-nephric bleeding, or increasing dulness in the peritoneal cavity if there be free bleeding through a rent in the peritoneum.

If there be hæmaturia without a lumbar swelling or signs of fluid in the peritoneum, it points to the fact that the capsule of the kidney has not been ruptured, and that the injury is limited to the substance of the organ itself,—a comparatively slight form of injury, in which the amount and duration of the hæmaturia vary considerably. In slight cases the urine, which at first appears to consist of almost pure blood, becomes clear in the course of two or three days ; the condition of the patient at the same time steadily improves, and he may be well in a week or ten days. There may however be profuse and persistent hæmaturia, and this is generally indicative of rupture of some considerable vessel ; indeed the bleeding may be so free that immediate operation is called for. In these cases the blood clots in the bladder and may give rise to retention of urine, or it may clot in the ureter, when the patient will have attacks of renal colic and pass casts of the ureter ; during these attacks the urine may be quite clear for a few hours. Associated with the hæmaturia there is generally frequent micturition.

In the course of ten days or so the urine may be free from blood, although it generally remains albuminous for some time longer. Nephritis may however occur, and there may be suppuration of the kidney or of the pelvis, the sepsis gaining access either from the blood-stream or by the passage of dirty instruments. In other cases suppression of urine may occur, due either to injury of both kidneys or to injury of one alone, in which case the suppression is reflex and is most likely to occur if the other kidney be diseased.

When the capsule of the kidney is ruptured, the shock is usually much more severe, and the blood, besides escaping by the ureter, finds its way into the tissues around the kidney, and, with the urine which is simultaneously extravasated, may form a large swelling in the loin, spreading upwards under the ribs and downwards towards the iliac fossa. There is usually extensive damage to the kidney—indeed the organ may be completely pulped-up—and the patient's condition is very serious.

When the peritoneum over the ruptured kidney is torn and there is extravasation of blood and urine into the peritoneal cavity, the shock is very profound, and there is rapidly increasing pain and tenderness over the abdomen, with extending dulness and possibly a swelling on the affected side. The pulse is quick, thready, and incompressible; the vomiting is intractable, and tympanites rapidly sets in. The want of limitation of the pain, dulness, and swelling, with the profound collapse, followed rapidly by signs of peritonitis, indicate the true nature of the lesion.

The chief dangers in connection with an injury to the kidney are continuous and excessive bleeding; inflammation and suppuration of the kidney itself or of the peri-nephric tissues, which may go on to septicæmia or pyæmia; and thrombosis of the renal vein, followed by emboli elsewhere. When the renal artery itself or one of its large branches is torn, gangrene of the kidney may ensue. Occlusion of the ureter by blood-clot, with consequent hydronephrosis and pyonephrosis, peritonitis, or possibly a traumatic aneurysm of the renal artery may also be met with. Death is usually due to collapse, to hæmorrhage, to peritonitis or, at a later date, to pyæmia, cystitis, hectic fever, or suppression of urine.

The chief difficulty in regard to treatment is to gauge the extent of the injury to the kidney; nevertheless this is a most important point, because it determines to a great extent the question of operative interference. In many of the slighter injuries to the kidney the patient recovers without operative interference, whereas in others his life will depend on early operation.

TREATMENT.—The treatment may be operative or non-operative. In the majority of cases, unless there be signs of serious hæmorrhage, non-operative treatment is employed for a few hours at any rate, and in many cases no operation is necessary.

(a) **Non-operative.**—The first indication is to combat the shock (see Part I., p. 141): warmth to the extremities, injections of camphor and strychnine,¹ and absolute rest in bed with the head low, should all be employed. It is well however to avoid using alcoholic stimulants for fear of increasing the hæmorrhage, and also of irritating the kidney.

The second indication is to give the parts as much rest as possible. The patient should be placed upon his back in bed, with the knees tied together and flexed over a suitable pillow which is prevented from slipping down by a

¹ The injections of Liq. strych. may be of ℥. v and upwards, repeated in 2 or 3 hours if necessary. ℥. xxx of a 20% solution of camphor in sterilised almond oil may be given similarly.

bandage passing from each end to the head of the bed. Should the dorsal position be intolerable, the patient may lie on the sound side. The affected side should be fixed either by strapping, or, if operation be probable, by a firm binder. If strapping be employed, the strips should be from two to three inches wide, and long enough to extend from just beyond the spinal column behind to beyond the middle line of the abdomen in front. They should be put on from below upwards, beginning just below the crest of the ilium and extending up well over the lower ribs, each piece overlapping its predecessor by at least two-thirds of its width. If the pain be severe, small doses of morphine may be given, unless renal disease be known to exist; the drug allays irritation and quiets the patient. The arm on the affected side should be fastened to the chest by a binder.

A third indication is to adopt measures to arrest the hæmorrhage. In the first instance it is well to administer an enema, so as to remove any faecal masses which may be lying in the colon, and which, by their pressure, may be giving rise to congestion. Ice may be given by the mouth, but nothing else must be taken at first for fear of exciting vomiting, which might seriously increase the bleeding from the kidney. If there be much blood in the urine, it is well to apply cold by Leiter's tubes over the kidney region, front and back. Subcutaneous injections of ergotine (℥. iii. x) are also useful, and should be employed in preference to hæmostatics by the mouth; these should not be given until 24 hours have elapsed, on account of the risk of vomiting being set up. Among the hæmostatics that may be employed internally are gallic acid (gr. x), pil plumbi c. opio (gr. ii-iv), and dilute sulphuric acid, which may be given with lemon syrup and which is very comforting when the patient suffers from extreme thirst, as he so commonly does.

During this early period no food by the mouth is required; anything necessary should be given in a rectal enema. It is well to empty the bladder both as a matter of diagnosis and also because there is often retention from shock, and a distended bladder causes backward pressure up the ureter, and may lead to increased extravasation of urine or congestion of the kidney. Every possible precaution must be taken to disinfect the orifice of the urethra and the instruments, because everything is favourable for the development of sepsis should infection take place (see Chap. XXXVI.).

These are the measures to be taken immediately on seeing a patient suffering from an injury to the kidney, but in a very short time—sometimes indeed from the first—the question of operation must be decided; the indications for operation are given below (see p. 189). If no operation be deemed necessary, the application of cold must be continued, and, if necessary, the injections of ergotine; when the stomach has quieted down, dilute mineral acids may be given by the mouth instead. The diet must be fluid, unirritating and restricted in amount. Milk only should be given for a few days, about four ounces every two hours. It is desirable to limit the amount of fluid absorbed, so as to minimise the work that the kidney has to

do, and the patient is usually able to stand a moderate amount of starvation. When obstinate vomiting is present, rectal feeding (see Part VI., Sec. I., p. 234) must be employed until it has quite ceased. The bowels, after being cleared out in the first instance, may be left alone for a day or two; the fæces must not be allowed to accumulate in the large intestine, and hence mild salines should be given after the second day.

An important point is the treatment of the hæmaturia. If this be profuse, the blood tends to clot either in the ureter or the bladder, and may cause much trouble. Clots in the ureter give rise to attacks of renal colic, and are apt to interfere with the renal circulation; a persistence of this trouble is one of the indications for operative interference. In most cases there is a certain amount of clot in the bladder, but usually it does not give rise to trouble unless the hæmorrhage be severe, when the clots may cause retention which it is difficult to relieve, as a catheter passes into the clot lying in the base of the bladder, and either fails to reach the urine above it or else the eye becomes blocked. When this happens, an attempt may be made to wash out the bladder with warm boracic lotion through a sterilised double-way catheter. This should not be tried, however, unless the surgeon is prepared to proceed further should the attempt fail, for when the clots are numerous the fluid may fail to return, and the only result is increased distension of the bladder. Attempts may be made to break up the clots by moving the end of the catheter about in the bladder, but should this fail, the best method is to use a lithotripsy evacuator. The large evacuating tube is not necessary here; a full-sized catheter with a large eye will suffice. The clots are gradually broken up by the action of the evacuator and withdrawn with the urine. It is most important to rid the bladder of clot, which is a fertile source of septic infection.

The foregoing method practically always succeeds when it can be used, but when there is a tight stricture or possibly an enlarged prostate it will be better, in the first instance, to aspirate the bladder above the pubes and thus to tap the urine above the blood-clot; the urine can be drawn off from time to time as it accumulates, while the clots gradually break up and are eventually discharged through the urethra. In some rare cases, when the bladder is packed full of clot, and there is much distress which aspiration fails to relieve, it may be necessary to perform a supra-pubic cystotomy (see Chap. XXIX.); if so, the greatest care must be taken to keep the urine aseptic.

(b) Operative.—Operation will be called for:

1. When hæmorrhage is profuse, and it is evident that if time be lost the patient may die of bleeding.
2. When serious hæmaturia persists.
3. When clots in the ureter persistently interfere with the flow of urine.
4. When there are signs of free hæmorrhage and extravasation of urine in the loin.
5. When the symptoms point to laceration of the peritoneum and extravasation of blood and urine into the abdominal cavity.
6. When there are signs of péri-renal suppuration.

In recent cases.—It is important not to persevere too long with expectant treatment or to be deceived by the small amount of blood escaping from the bladder, and thus to overlook an accumulation of blood and urine in the loin or in the peritoneal cavity. Exposure of the kidney in order to ascertain the nature of the trouble and remedy it is not a very serious operation, and more lives have no doubt been saved by operations of this kind done early than by watching the case too long; if intervention be delayed until the patient is almost moribund from loss of blood, from peritonitis or from peri-renal cellulitis, a good result cannot be looked for. Hence the rule will be that whenever the surgeon has reason to believe that extravasation of urine is occurring, or that there is active hæmorrhage in spite of treatment, or that a complication such as peri-renal cellulitis or peritonitis is occurring, the kidney should be exposed without delay.

Except when there is reason to believe that extravasation is taking place into the general peritoneal cavity, the exploration of the kidney should be made through the loin, and the organ is reached as for movable kidney (see p. 178); but, as it is here desirable to explore and clear out the whole region around the kidney, the deeper muscles should be separated to the same extent as the skin wound so as to open up the whole field of operation. When the kidney has been exposed, the further steps will depend upon what is found. In most cases the capsule will be torn, and blood and urine will be extravasated into the loin, and therefore blood-clot and possibly urine will be found surrounding the kidney as soon as the peri-renal fat has been opened up. This must be cleared out and, if free bleeding be going on, the pedicle of the kidney should be grasped between the fingers of the left hand and its vessels compressed; then the clearing-out of clots and the examination of the kidney can be proceeded with and, when this has been done, the compression of the pedicle of the kidney can be entrusted to an assistant, so that the surgeon has both hands free. Any vessel bleeding outside the kidney is clamped, and the organ is isolated and brought out into the wound.

The subsequent treatment will depend upon the nature of the lesion found, and the question will be whether conservative treatment will suffice or whether nephrectomy is necessary.

Nephrectomy is indicated when the kidney has been so damaged that the patient, apart from the risk of hæmorrhage and suppuration that he must run, will be left with a kidney that is useless to him if he recovers; this is likely to be the case when the damage is great and extends into the pelvis or the upper part of the ureter. It may also be necessary when the bleeding comes from one of the main arteries ligature of which would probably mean sloughing of a portion of the kidney, and it is necessary in the great majority of cases in which the peritoneum has been torn and blood and urine are effused into the peritoneal cavity. It is obviously the only course open when the kidney substance is completely pulped-up.

Conservative treatment.—In many cases nephrectomy is not necessary. For instance the organ may be torn more or less completely across by a clean-

cut laceration, there may be more than one laceration or portions may be partially detached ; finally, a part of the kidney may be badly pulped.

The arrest of hæmorrhage is the first consideration, and it may be effected by tying bleeding points, by plugging the wound in the kidney or by firmly opposing the cut surface by sutures. The chance of tying the bleeding vessels is small, as ligatures will cut through the renal cortex and are useless unless some of the smaller branches of the renal artery are torn close to the hilum or in the capsule. Moreover ligature of the main branches of the renal artery will entail sloughing of a corresponding portion of the kidney, and hence in the great majority of cases the best method of arresting hæmorrhage is either by plugging or by deep sutures, and of these the latter plan is much superior and should be adopted wherever possible. Two or three mattress sutures of

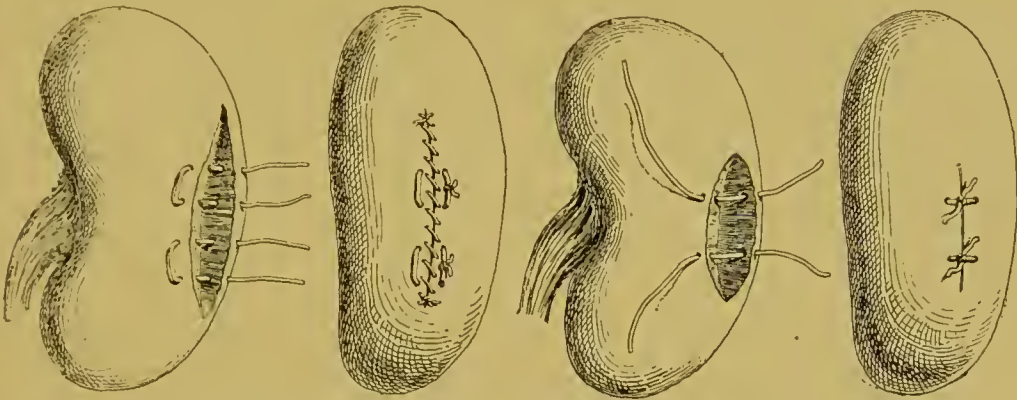


FIG. 44.—METHODS OF SUTURING A LACERATION OF THE KIDNEY. Two methods are shown. The two left-hand sketches show how an extensive laceration may be repaired by means of deep mattress sutures, reinforced by a continuous suture through the capsule. The two right-hand figures show how a smaller wound may be closed by deep sutures only. As a rule the lacerations of the kidney are transverse to the long axis of the organ rather than vertical as depicted above.

chromicised catgut or kangaroo tendon passed deeply through the kidney (see Fig. 44) and tied outside the capsule will press the torn surfaces as firmly together as can be wished, and will generally arrest the hæmorrhage ; the method is also applicable when there is more than one rent, provided that the kidney substance be not actually pulped-up. The sutures must not perforate the calices or the pelvis of the kidney and may be reinforced by a continuous catgut suture which unites the rent in the capsule. A great advantage of this method is that it not only stops the hæmorrhage but also prevents the escape of urine into the peri-renal tissues.

After the rent has been stitched up, two or three sutures should be passed between the capsule of the kidney and the lumbar muscles so as to anchor the kidney in place,¹ and drainage tubes are inserted well into the peri-renal space so as to carry off all urine or blood ; these may be removed in three or four days if there be no further accumulation. The abdominal wall should be repaired

¹ These stitches should be made to emerge through the skin of the loin, so that they may be removed subsequently. It is well to avoid buried sutures as much as possible, in case suppuration should occur.

by silkworm-gut sutures passing through the skin and the whole thickness of the loin muscles, so that no buried stitches are left to come out should the wound suppurate. The stitches are kept in for ten days or a fortnight.

When a portion of the kidney is almost detached, the question will arise whether the surgeon should merely remove this portion or should take away the whole kidney. The decision depends upon the possibility of arresting the hæmorrhage; if this be only moderate in amount after the lacerated portion has been removed, stitching the kidney to the abdominal wall and the application of a firm tampon of gauze may suffice.

When the kidney is much torn and it is impossible to arrest the hæmorrhage by sutures, the only plan is to plug the laceration with strips of aseptic gauze, if an attempt is to be made to save the kidney. The organ must first be sutured to the loin and then the torn portion is tightly plugged with gauze. The results are not very good because it is difficult to exert sufficient pressure on the kidney to effectually arrest the hæmorrhage. The gauze employed should be boiled and the skin around must be thoroughly cleansed, because infection and suppuration are very apt to occur. When plugging with gauze is employed, no drainage tube is necessary because the gauze itself acts as a drain. The greater part of the wound will have to be left open, but silkworm-gut sutures may be carried through the whole thickness of the loin, and the loops tied and left ready to tighten up as the gauze is removed. Should no suppuration occur, it will be several days before the deepest portion of the gauze will come away easily; if there be no suppuration, the loose stitches are tied as it is gradually removed. The patient must lie on his back, or with a pillow beneath the injured side, while the corresponding arm is fixed to the trunk by a binder, and the legs are flexed over a pillow and the knees tied together.

When the peritoneum is lacerated and there is extravasation of blood and urine into the peritoneal cavity, immediate operation is imperative. The operation should be trans-peritoneal, the incision being just outside the linea semilunaris on the affected side (see p. 250). When the abdomen has been opened, the peritoneum outside the colon is divided, the latter drawn towards the middle line, and the kidney exposed. In the majority of cases the best plan is to proceed at once to do nephrectomy, unless there be reason to suspect serious disease of the other kidney. In a few cases possibly the rent in the kidney may be small and can be closed by mattress sutures (*vide supra*); in that case a counter-opening for drainage is made in the loin, and the rent in the peritoneum is sewn up. As a rule however nephrectomy is advisable not only on account of the severe lesions in the kidney, but to prevent escape of urine into the peritoneal cavity after the operation. The operation is terminated by the removal of the blood and urine from the peritoneal cavity, particularly from Douglas's pouch to which it usually gravitates; finally, the abdomen is irrigated with salt solution. If the operation be done early, sepsis may not have occurred, and will be avoided should subsequent escape of urine into the abdominal cavity be prevented.

In long-standing cases.—The surgeon may not operate until some considerable time has elapsed, or he may not see the patient until several days after the injury. Here an exploration may be necessary on account of secondary hæmorrhage, but it is more probable that operation will be called for on account of peri-nephric suppuration or a large collection of blood and urine, and the treatment will vary accordingly.

The treatment of secondary hæmorrhage is difficult, as it is hard to identify the bleeding point, or to secure it when found. The best plan is to turn out the clot and urine as completely as possible, and then, having found the spot from which the bleeding is coming, to plug the wound firmly with strips of aseptic gauze if attempts at clamping fail. Enough pressure can always be brought to bear, as by this time the kidney is firmly fixed by adherent clot. The packing is removed as it gets loose, and renewed until all bleeding has stopped, when the incision in the loin may be brought together over a tube if there be no suppuration. For the treatment of peri-nephric suppuration see Chapter XX.; the probability is that nephrotomy and drainage will suffice unless there be foci of suppuration scattered through the substance of the organ, when nephrectomy will give the patient a better chance. When suppurative peritonitis has resulted from a wound of the peritoneum, the treatment must be on the general principles previously laid down (see Part VI., Sec. I., p. 401).

INCISED AND PUNCTURED WOUNDS.

These are rare in civil practice and are usually accompanied by injuries of other structures, such as the peritoneum, colon, spleen, etc., and they may or may not be accompanied by protrusion of the organ. All the conditions that occur after subcutaneous injuries may be met with in these wounds, with the addition that, if the external opening be sufficiently large, blood and urine escape through it.

TREATMENT.—When the wound is a mere puncture limited to the kidney and not accompanied by any serious hæmorrhage or escape of urine, nothing is necessary, in the first instance at any rate, beyond enlarging the wound sufficiently to secure disinfection of the soft parts. When the injury is more severe and is accompanied by brisk hæmaturia and signs of accumulation of fluid in the loin or in the peritoneum, it is desirable either to enlarge the opening sufficiently to expose the kidney, or else to do this through the ordinary lumbar incision. The treatment of the damaged organ itself will be upon the same lines as those already described for subcutaneous lacerations.

Hernia of the kidney.—The kidney is sometimes protruded partially or entirely through the wound in the loin, and the treatment then will depend upon the condition of the viscus. If it be seriously damaged and there is little chance of its recovery, it will of course require removal. Slighter forms of injury must receive treatment on the lines already laid down (*vide supra*).

Among the later results of injury to the kidney, Morris refers to the formation of an *aneurysm of one of the branches of the renal artery*. This is a very

rare occurrence, and it is hardly necessary to go into the treatment because the diagnosis is rarely made during life, most of the recorded cases having been looked upon as malignant tumours of the kidney. Should such a case be met with and diagnosed during life, the only treatment is nephrectomy, and the feasibility of this depends largely upon whether the renal artery itself is involved, and whether it is possible to apply a ligature between it and the aorta.

INJURIES OF THE URETER.

Injuries of the ureter may occur independently of injury to the kidney, and are perhaps most common during an abdominal operation. Subcutaneous rupture of the ureter is known, but the accident is extremely rare. The symptoms are collapse, hæmaturia, pain and tenderness, vomiting and the formation of a swelling in the iliac region.

Should the condition be diagnosed, the treatment will be to expose and attempt to repair the torn ureter or, failing that, to implant it into the bladder or the bowel (*vide infra*). When this is impossible nephrectomy will be necessary.

The more important cases are the injuries occurring during some abdominal operation, such as vaginal hysterectomy, ovariectomy, or the removal of the Fallopian tubes. They may be divided into four groups :

- (a) Complete division of the ureter.
- (b) Complete division with loss of a portion of the ureter.
- (c) Partial division.

(d) Inclusion of a portion of the ureter in a ligature followed by subsequent sloughing. Sloughing of the ureter may also occur after child-birth from prolonged pressure.

The injury may be recognised immediately it occurs, or it may not be noticed until some hours afterwards when urine begins to escape from the wound ; when the ureter has been included in a ligature, the true condition may not be recognised until the ligature has separated, and a ureteral fistula has become established. If the condition be not recognised at the time of the operation, the prognosis will depend to a considerable extent on whether the urine escapes into the peritoneal cavity or into the vagina, and also on whether the urine is aseptic or not. If aseptic, its escape into the peritoneal cavity may merely give rise to a localised collection of urine, which gradually makes its way through the line of incision and leads to a urinary fistula ; if it be septic there will be acute peritonitis.

TREATMENT.—As wounds of the ureter are rare and are comparatively seldom recognised, most of the suggestions as to treatment are based upon experiments on the lower animals rather than upon actual operations on man. At the same time a certain number of cases have been done in man and they help to indicate which are the best methods.

We shall consider the treatment under the following heads :

- (a) When the injury is recognised at the time.

(b) When the injury is not recognised until some hours later.

(c) When the injury is unnoticed until a ureteral fistula is established. The treatment will vary according as the ureter is completely or partially divided, and in the former case according as a portion has been lost or not.

The most important cases are those in which the injury is recognised at the time of the operation, and the surgeon has to repair it on the spot, and has no time to consult authorities. When a fistula has developed, he has time to plan out the most appropriate procedure and can make a choice from a large number of methods. As many of these are essentially experimental, we need not deal with them in detail; they will be found in full in Morris's work.¹

In the early days of hysterectomy and ovariectomy the only suggestion to meet such an accident was to remove the kidney on the affected side. This is a most serious procedure, and at the present time, nephrectomy is the surgeon's last resort. Primary nephrectomy for wounds of the ureter may be entirely dismissed; secondary nephrectomy may be required later on should the kidney become disorganised by sepsis or hydronephrosis or should the patient insist on having the organ removed owing to the annoyance caused by a permanent urinary fistula.

Morris (*loc. cit.*) summarises the chief methods of dealing with this accident as follows:

1. Ligaturing both ends of the divided ureter and dropping them back into the abdominal cavity.
2. Ligaturing the distal end only, and suturing the proximal one in the abdominal wound.
3. Uniting the divided ends by some form of ureteral anastomosis.
4. Grafting the proximal end into the bladder.
5. Grafting the proximal end into the bowel.
6. Detaching the bladder or creating a diverticulum in it so as to graft the ureter into it when a portion of the latter has been lost.
7. Nephrectomy.

(a) **Of recent wounds.**—The most reliable method is some form of uretero-ureteral anastomosis when no loss of the ureter has occurred, or grafting the proximal end of the ureter into the bladder or the bowel, or bringing it out on the skin when so much of the tube has been lost as to render the former method impossible. The suggestion has been made to apply a ligature to each end of the divided ureter, and then to leave the parts alone for a few days, after which the wound is opened up again and a plastic operation or a secondary nephrectomy performed. This procedure, which would only be considered when the patient's condition is so bad as to preclude immediate repair, is probably, however, not so good as that of temporarily bringing the divided end of the ureter into the vagina.

Uretero-ureteral anastomosis.—The different methods of uretero-ureteral anastomosis are founded on Fenger's experiments, and may be divided into four groups: (a) Ordinary end-to-end union; (b) Oblique end-to-end union;

¹ Morris, *Op. cit.*, Vol. II., Chap. XV.

(c) End-in-end union; and (d) Lateral implantation. For a full description of these operations the reader is referred to Morris's work.

End-to-end anastomosis may be dismissed by saying that, as it consists essentially of transverse union by sutures applied after Lembert's fashion, leakage is apt to occur and stenosis is almost certain to follow, owing to the narrowness of the canal and the inversion of the cut edges, increased by the cicatricial contraction of the tissues during healing. The ends of the ureter may also be cut obliquely and sutured end-to-end by mattress sutures

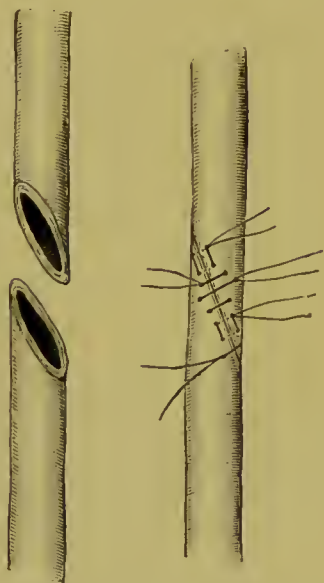


FIG. 45.—END-TO-END UNION OF A DIVIDED URETER AFTER OBLIQUE SECTION. The ends are united both by mattress sutures and by interrupted stitches. The method is that described by Bovée. (Morris.)

inserted in Lembert's fashion (see Fig. 45), and this method is more likely to avoid a stricture than the transverse suture. *End-in-end operations* are only applicable when the ureter is much dilated, their object being to pull one end of the ureter into the other, and secure them together; the method however is apt to be imperfect.

Lateral implantation.—This is the method which apparently gives the best results and the one we shall describe, as the surgeon must be acquainted with it, since he may have to practise it in an emergency. *Van Hook's method* is to ligature the distal portion of the ureter about a quarter of an inch from its cut end. A longitudinal incision is then made below this with sharp-pointed scissors, the length of the incision being double the diameter of the tube. The proximal end of the ureter is then slit up for about a quarter of an inch; this enlarges its opening, and

therefore allows for any subsequent contraction. Two needles, armed with a single catgut thread, are then passed through the upper end of the ureter about an eighth of an inch from the cut edge from within outwards, the needles being $\frac{1}{16}$ th to $\frac{1}{8}$ th of an inch apart (see Fig. 46). The loop of catgut thus grasps the end of the ureter firmly. The needles are now carried through the slit in the lower end of the ureter down the tube for half an inch, and are pushed obliquely through the wall of the duct side by side. The catgut is pulled upon, the upper end of the ureter is drawn into the lower, and the loop is tied. A continuous Lembert suture finally surrounds the line of union of the two portions. The ureter is now carefully enveloped by peritoneum, or a fold of omentum is sewn over it; the former plan is the better. Care must be taken to avoid soiling the wound and the peritoneal cavity. The parts should be packed off and the ends of the ureter covered until the surgeon is ready to unite them; before proceeding with the union, the ureter should always be probed to see that it is patent.

A drainage tube should be inserted down to the ureter, but not actually touching it ; if no leakage or sepsis occur it can be dispensed with in the course of three or four days. A catheter should be retained in the bladder for two or three days in order to prevent strain upon the sutures by backward pressure of the urine when the bladder becomes distended.

Ureteral grafting.—Ureteral anastomosis is not always applicable, even in recent cases ; it is difficult to carry out when the ureter is wounded low down in the pelvis, and, when the operation is done for a fistulous opening, the difficulties are greatly increased by the involvement of the ends of the

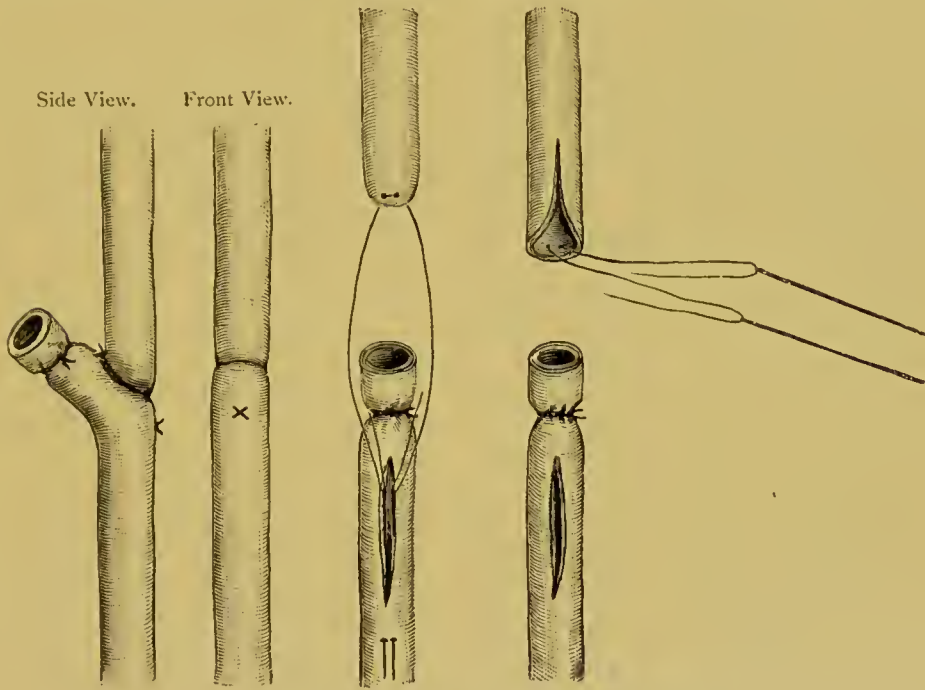


FIG. 46.—VAN HOOK'S METHOD OF URETERO-URETERAL ANASTOMOSIS BY LATERAL IMPLANTATION. The two right-hand figures show the appearance of the ureter when the anastomosis is complete. The X on the second figure is the point at which the ligature emerges from the lower end and is tied. (*Morris.*)

ureter in the cicatricial tissue. Hence, when the ends of the ureter cannot be approximated without undue tension, some other plan must be adopted ; the alternatives are grafting the ureter into the bladder, the intestine, or the vagina, or attaching it to an opening in the skin.

The ideal operation is to graft the ureter into the bladder, and this should be done when the site of injury is quite close to that structure. Grafting it into the bowel is a much more serious operation, partly on account of the risk of stenosis of the ureteral orifice, and partly because of the danger of ascending septic infection. If the ureter is to be grafted into the bowel, it is better to implant it into the colon than into the rectum, as in the former case there is more room for accumulation of the urine, and therefore there is not the same necessity for repeated evacuations, while at the same time the contents of the bowel pass on more quickly, and are not so long in contact with the ureteral orifice. Bringing the end of the

ureter out on to the skin no doubt also entails a certain risk of ascending septic infection, but this may be minimised by careful attention. The escape of urine on to the skin however is most objectionable, and in most cases, when the other kidney is sound and it is impossible to restore the lumen of the ureter, the patient will elect to undergo a secondary nephrectomy. Almost preferable to creating a cutaneous urinary fistula is grafting the proximal end of the ureter into the vagina. An attempt may then be made to perform uretero-vesical grafting subsequently. It is only when the damage to the ureter is too high up for this that the ends should be brought out on the skin. The steps of the method are described in connection with ureteral fistula (*vide infra*). In practice it has to be remembered that, if the ureter be injured in the course of a severe abdominal operation, such as hysterectomy, the patient may not be able to stand any elaborate procedure, such as uretero-ureteral anastomosis or uretero-vesical grafting; and under these circumstances it may be necessary to bring out the proximal end of the ureter either into the wound or into the vagina, after applying a ligature to the distal end. The patient is thus left with a fistula, until she is well enough to undergo a more elaborate plastic operation.

Nephrectomy.—Nephrectomy is a last resource and should only be employed as a secondary procedure where the kidney has become disorganised by ascending septic infection or by hydronephrosis or when the surgeon fails to cure the fistula and the patient insists on having something done to get rid of it.

When the ureter is only partially divided by either a longitudinal or an oblique incision, such for instance as is made for the removal of an impacted stone, it should be closed by Lembert sutures and a drainage tube inserted down to the incision, in case extravasation should occur. If the wound be intra-peritoneal, the line of suture should be covered by a fold of peritoneum or by an omental graft; if it be retro-peritoneal, it may suffice to introduce a tube down to the vicinity of the opening without attempting suture. In the rarer cases in which a portion is cut out of the side of the ureter, an attempt may be made to close the opening by increasing the transverse diameter of the ureter, as is done in pyloroplasty (see Part VI., Sec. I., p. 238).

(b) Of ureteral fistula.—These fistulæ may open on to the skin or into the vagina, and may give rise to so much annoyance that operative measures must be undertaken for their cure. These are three-fold, namely, implantation of the divided end of the ureter into the bladder, or into the bowel, or nephrectomy. These operations may also be required for stricture at the lower end of the ureter, when resection of portions of the bladder involves the ureteral orifice, in certain cases of calculus impacted at or near the lower end of the ureter, or in cases of cancer of the uterus or other pelvic organs involving the ureter.

Uretero-vesical anastomosis.—This has been done successfully on several occasions. The ureter may be reached either behind or through the peritoneum, or through the vagina in the female.

The trans-abdominal extra-peritoneal method.—This operation has been

done by Novaro in the following manner:—The patient was placed in the Trendelenburg position, a median laparotomy was performed, the peritoneum opened and the intestines retracted. The ureter was traced down and its lower end freed from the vagina (Novaro's case was one of uretero-vaginal fistula). The lower end was split up for about one centimetre, and the bladder was then projected in the neighbourhood of the ureteral orifice by means of a sound introduced into it. An incision was next made into the bladder about two fingers' breadth above the normal ureteral opening and into that the end of the ureter was sewn by sutures taking up the whole thickness of the walls. The incision in the pelvic peritoneum was then closed, the peritoneum detached from the pubes backwards to the region of the anastomosis, and a drain introduced so that any leakage that might occur should be extra-peritoneal.

In Witzel's operation (see Fig. 47) a laparotomy was done and a small incision was made in the peritoneum over the iliac vessels and the ureter isolated. By slight traction the ureter was then defined in the broad ligament, where an incision was made through the peritoneum over it and it was divided between two ligatures by an oblique cut. The distal end was buried, while the proximal end was pulled out through the incision over the iliac vessels, and then a

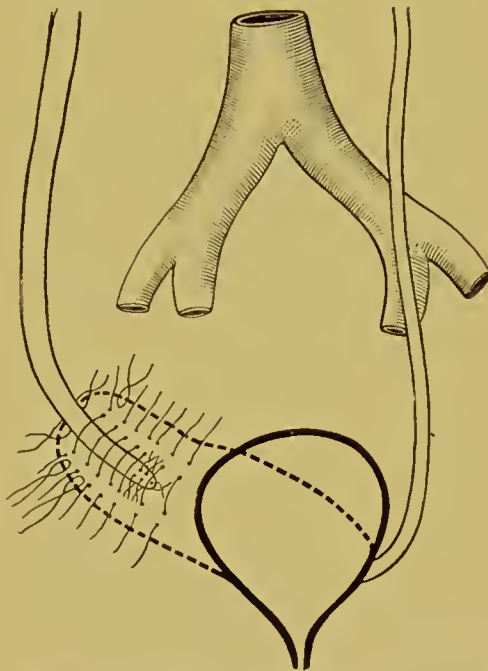


FIG. 47.—WITZEL'S OPERATION OF URETERO-VESICAL ANASTOMOSIS. (*Morris.*)

pair of long forceps was insinuated behind the peritoneum from the abdominal incision near the bladder up to this incision and the ureter was seized and drawn down to the bladder. All the incisions in the peritoneum were then closed so that the remainder of the operation was done extra-peritoneally. The bladder was distended with boracic lotion and brought over to the affected side so that the end of the ureter could readily lie upon its upper surface, and was fastened by a few sutures to the transversalis fascia. A small opening was next made in the bladder opposite the point where the lower end of the ureter touched it, and the latter was then attached to the bladder by two rows of sutures, the first uniting mucous membrane to mucous membrane and the second joining the muscular coats only. A fold of the bladder was made, parallel to the ureter, and the lips of this were united so as to form a complete canal in every respect resembling Witzel's operation for gastrostomy (see Part VI., Sec. I., p. 221). A catheter was left in the bladder and a drain carried down through a separate opening in the abdominal wall.

It has been proposed to reach the ureter through the lumbo-ilio-inguinal incision (see p. 219), but this is a much more difficult method. It has also been proposed to reach it through the bladder wall, by the sub-pubic or even by the sacral route.

Intra-peritoneal methods.—Here the ureter is dissected from its bed and drawn across the peritoneal cavity and the pelvis to reach the bladder. This may be the only way available when much of the ureter has been lost. Details of most of these operations are given by Morris (*op. cit.*).

Vaginal operations.—These fall into two groups : (a) Those in which the entire fistulous orifice is grafted into the bladder ; and (b) those in which the fistulous orifice is removed, and a new communication is made between the end of the ureter and the bladder. Grafting of the fistulous orifice bodily into the bladder seems the better procedure, both as giving a more extensive area for union, and also because a new ureteral orifice has already been established and because the chances of contraction and ascending infection are less than when a fresh orifice is made. The fistulous opening into the vagina is surrounded by an incision which embraces the whole thickness of the vaginal wall, and the flap containing the end of the ureter is freed. The incision is carried forwards sufficiently to expose the bladder wall, which is incised at a suitable spot. The edges of the flap containing the end of the ureter are then sutured to the bladder wall by a double row of sutures, and the wound in the vagina is closed.

General considerations.—These operations can only be employed when the injury in the ureter is close enough to the bladder to allow the two structures to be united without undue traction. Tension not only prevents union by pulling the two structures apart, but tends to diminish the calibre of the ureter and thus may produce hydronephrosis. There is a risk of stenosis and of renal infection from ascending sepsis in every method, but these are not sufficient arguments in favour of nephrectomy as opposed to a plastic operation. The liability to stenosis is diminished by slitting up the end of the ureter before it is united to the bladder, and the risk of the infection of the kidney is not very great if the patient be in good condition and the bladder healthy. Even when there is a certain amount of pyelitis already existing, it seems better to perform this operation than to resort at once to nephrectomy. The chief trouble after these operations is due to the absence of the valvular orifice, so that, when the patient micturates, urine is forced up through the ureteral orifice, causing backward pressure on the kidney ; probably the more obliquely the ureter is united to the bladder, as in Witzel's method, the less is the chance of regurgitation. A catheter should always be kept in the bladder for some days after the operation, in order to prevent any distension or backward pressure.

Uretero-intestinal anastomosis.—When the fistulous opening is in such a position that the ureter cannot be made to reach the bladder, the procedure that suggests itself is grafting the ureter into the intestine, and this has been done in several cases with success. It has been performed not only for a fistula of the ureter, but also for malignant disease in the pelvis blocking the

ureters, and for extroversion of the bladder. For choice the grafting is done into the sigmoid flexure on the left side, and into the cæcum on the right. Chaput's method (see Fig. 48) is perhaps the best.

The incision begins at the costal margin, about three inches from the middle line, runs down to the level of the anterior superior iliac spine, and then curves inwards to a point a little less than two inches from the middle line. The peritoneum is opened, the coils of intestine are pushed aside, the posterior parietal layer of the peritoneum is incised in the iliac region parallel with the insertion of the meso-colon, and the internal edge of the incision is seized with forceps, and the peritoneum stripped up as far as the vertebral column. The ureter is now sought for and divided between forceps, the lower end is

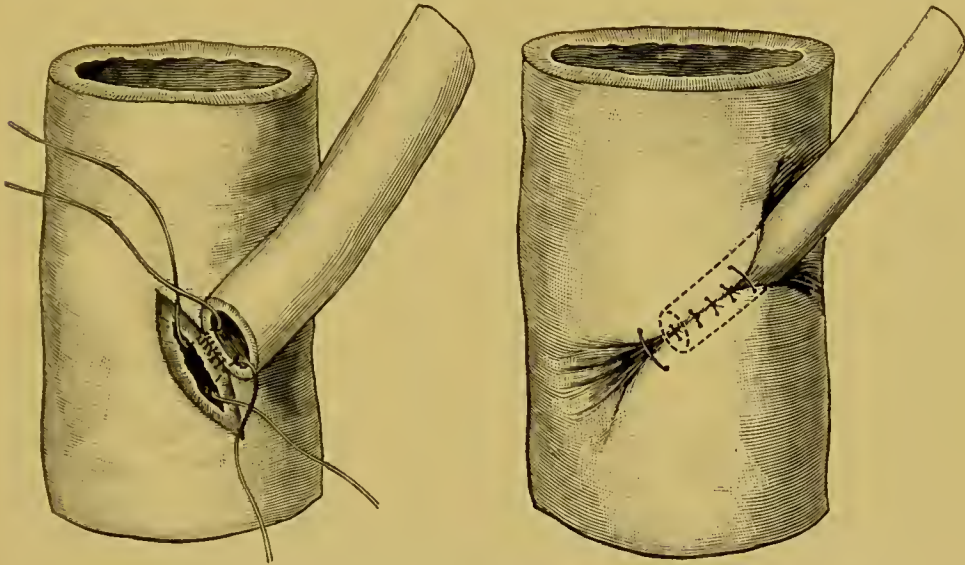


FIG. 48.—CHAPUT'S METHOD OF URETERO-INTESTINAL ANASTOMOSIS. The end of the ureter should be cut obliquely. (Morris.)

ligatured and replaced, while the upper end is implanted into the postero-internal aspect of the colon. In doing this the lower lip of the ureteral orifice, which should be cut obliquely, is first attached by three or four Lembert sutures to the bowel; the latter, after having been previously clamped, is incised in a direction corresponding to the ureteral orifice, and the mucous membrane of the latter is attached to that of the bowel by a continuous catgut suture. An external continuous Lembert suture is then put in and the end of the ureter is buried in the wall of the colon for about an inch by a double row of Lembert sutures. The incision in the peritoneum is closed by a catgut suture, and the abdominal wound is closed, drainage being provided through a counter-puncture in the loin.

The ill-results that may follow grafting into the bowel are stenosis, with consequent hydronephrosis (which may occur after any of these plastic operations), infection by the bacillus coli communis, and infective peritonitis. In cases such as extroversion of the bladder where the natural ureteral orifice exists, and can be grafted bodily into the rectum, the result is excellent.

When a considerable amount of the ureter has been lost, attempts have been made to form a new channel connecting the two ends instead of implanting the upper one into the bladder or rectum. This new channel is formed either of skin, peritoneum, bladder, or bowel. These operations have not as yet been very successful, and for the details of those already done the reader should refer to Morris's work on the subject, to which we are indebted for many of the above points, and which contains the best account of this very difficult subject.

CHAPTER XX.

THE INFLAMMATORY AFFECTIONS OF THE KIDNEY, URETER, AND THE PERI-NEPHRIC TISSUES.

WE shall only deal here with the inflammatory affections that come under the care of the surgeon. They are practically all of a suppurative character, and may be divided into three classes: 1. Peri-nephric suppuration; 2. Pyelitis and pyonephrosis, where the suppuration affects the pelvis of the kidney; and 3. Pyelonephritis, where the inflammation affects the substance of the kidney as well as the pelvis, and where, in some cases, such as "surgical kidney," the substance of the kidney itself is essentially the seat of the inflammatory trouble.

PERI-NEPHRIC SUPPURATION.

Non-suppurative inflammation of the tissues around the kidney may occur in connection with inflammation in the kidney itself, such as pyonephrosis or tuberculosis, giving rise to adhesions between the capsule of the kidney and the tissues around, or to displacements of the organ. This affects the question of nephrectomy, but does not of itself call for any special treatment. The important cases are those of peri-renal abscess.

Abscesses in the peri-renal region may be due to various causes, some of them independent of disease of the kidney; when they arise in connection with renal disease, the abscess may or may not communicate with the interior of the kidney or its pelvis. Hence we may classify peri-renal abscesses into three groups: (*a*) Those independent of disease of the kidney; (*b*) Those which occur along with inflammation of the kidney, but in which there is no communication between the abscess and the interior of the organ; and (*c*) Those in which the peri-renal abscess is due to a fistulous communication between the interior of the kidney and the fatty capsule.

Peri-nephric suppuration independent of renal disease may follow injuries such as a blow on the loin, a strain or a punctured wound not involving the kidney. Sometimes the only history is that of a chill preceding the develop-

ment of a peri-nephritis. Abscesses may also result from extension of inflammation from neighbouring parts such as the appendix, the pelvis, the colon, the duodenum, or the gall-bladder. Peri-nephric abscess may also occur in the course of some general septic condition or of a specific fever.

Of the two other varieties of peri-nephric abscess, it is more common for the abscess to originate in connection with pyelitis or pyelonephrosis, with or without perforation of the kidney substance. Here there are symptoms of kidney trouble, such as hæmaturia or pyuria, in addition to the signs of peri-nephric suppuration.

SYMPTOMS.—These vary according to whether suppuration has actually occurred or whether the case is seen before the abscess has formed. Peri-nephric inflammation is indicated by a peculiar flexion of the spine which is bent somewhat antero-posteriorly, and inclined to the affected side. The patient experiences pain in walking or stooping, and at the same time the affected thigh is drawn up and can only be moved with pain. The temperature is high— 103° to 104° F.—and there is generally intense, deep-seated tenderness in the loin, most marked above the crest of the ilium, and just outside the erector spinæ muscle.

When actual suppuration has occurred, there are often rigors, the pain is increased, and there is cedema of the cellular tissue in the flanks with firm contraction of the loin muscles, and subsequently a tumour, which may be found to fluctuate under an anæsthetic. This symptom is best examined for with one hand on the front of the abdomen and the other in the loin. It is seldom, however, that the case is allowed to go on until actual fluctuation can be made out. The presence of pus will be inferred from the length of time the inflammation has lasted, the character of the temperature and the information afforded by a blood-count (see Part VI., Sec. I., p. 379). Unless the peri-nephric inflammation be secondary to suppuration in the kidney, examination of the urine does not help the diagnosis. Some information as to the site of the abscess may occasionally be gained by noting the character of the pain. When the abscess occurs about the upper part of the kidney this is usually of a pleuritic character. When the suppuration is opposite the centre of the organ it is referred along the ilio-hypogastric and ilio-inguinal nerves, and gives rise to pain in the groin and scrotum, which may serve to distract attention from the actual seat of the inflammation. When the abscess originates about the lower end of the kidney the pain is mainly referred to the hip and thigh, along the external cutaneous, anterior crural and obturator nerves, and there may be pain in the knee and retraction of the testis.

If left alone, the abscess spreads in directions varying according to the situation in which it originates. An abscess in the upper part spreads forwards, and gives rise to a sub-phrenic abscess or an empyema. When in the lower part it spreads downwards to the iliac fossa, and may point in the neighbourhood of Poupart's ligament. Pus from about the centre of the renal area has a tendency to spread directly backwards and point in the loin. The

pus contained in the abscess has often a faecal odour, although there may be no communication with the bowel, and it is not uncommon to find the colon bacillus present in large numbers.

The *diagnosis* is often difficult in the early stages, and the affection may be mistaken for hip disease, lumbago, spinal disease, empyema or pneumonia. If, however, the possibility of peri-nephric suppuration be borne in mind, a careful examination of the symptoms given above will generally enable a right diagnosis to be arrived at. It is more difficult to say whether the abscess has arisen primarily outside the kidney or whether it is secondary to renal disease. The points in favour of a diagnosis of a true primary peri-nephric suppuration will be chiefly negative, such as the absence of changes in the urine or other signs of renal mischief, while the diagnosis is greatly strengthened by a history of injury or exposure, or possibly a history of old appendicitis.

TREATMENT.—This will vary with the period at which the case is seen. For the first few days after the commencement of symptoms the case must be treated as for the early stages of inflammation (see Part I, p. 3). The patient should lie absolutely at rest on his back with the knee on the affected side flexed over a pillow, while saline aperients and, if necessary, enemata should be given every day in order to keep the colon unloaded. If the pain be severe, morphine may be administered. In the early stages cold, either by means of an ice-bag or by Leiter's tubes, may be employed. Tincture of aconite and vinum antimoniale may also be given. Occasionally hot fomentations give more relief than the application of cold, in which case they should be used instead.

Should the symptoms of brisk inflammation persist after five or six days, it may be assumed that suppuration has taken place, and an exploratory incision should be performed without delay. The incision should be made about half an inch below the lower border of the twelfth rib; it should commence above close to the edge of the erector spinæ, and should run thence outwards and somewhat downwards for about three inches.

It has been advised that the loin should be punctured first to ascertain if pus be present, but we cannot recommend this, as the needle may do damage or may fail to find pus that is actually present, and so may delay the necessary incision. The incision recommended above, *i.e.* that for nephro-lithotomy (see p. 227), should always be adopted, as the surgeon can never be sure that he may not have to deal with a stone in the kidney. It need not be so free as the ordinary nephro-lithotomy incision in the first instance, as it can be easily enlarged subsequently, should this be necessary. The soft parts are divided in the usual manner until the transversalis fascia has been opened, when the finger is introduced and the peri-nephric tissues are palpated. Palpation will indicate the whereabouts of the chief swelling, and either the finger or a pair of dressing forceps may be pushed in this direction in order to open the abscess cavity. It is well to palpate carefully before doing this, as the abscess may lie either at the upper or the lower end of the kidney, and might therefore otherwise escape. When the pus begins to flow, the

patient is turned over almost on to the back, so as to allow it to escape freely, and, while it is running out, the opening into the abscess should be kept as much as possible up into the wound, so as to prevent pus flowing back between the transversalis fascia and the peri-nephric fat where it might set up fresh inflammation.

After the bulk of the pus has been evacuated, the finger is passed into the abscess cavity, partly to see if any loculi be present and, if so, to break down the septa between them, and partly to ascertain if there be any communication between the abscess cavity and the interior of the kidney. The latter object is best attained by gently washing away any pus in the depths of the wound with warm saline solution, and retracting the parts thoroughly in a good light. The irrigation must be done extremely gently, and not under any pressure at all. Should a communication be found with the kidney or its pelvis, appropriate treatment must be adopted, but this is dealt with separately. If no communication of this kind be found, the peri-nephric abscess is treated in the ordinary manner, large drainage tubes being introduced in any direction in which there is a distinct prolongation of the cavity; usually two or three large tubes (No. 24) will be required at first. No sutures should be inserted in the loin, but the tubes should be fastened to the skin with silkworm-gut stitches to prevent their slipping into the cavity. The subsequent treatment is that of an ordinary abscess, taking care not to remove the drainage tubes too soon, as otherwise fistulous openings are likely to occur from imperfect drainage. The lumbar muscles are very apt to contract and to close the wound in the skin very rapidly, and this is one of the reasons for not putting in any stitches.

Should there be any extensive prolongation of the abscess cavity, either upwards or downwards, counter-openings may be required either in the sub-phrenic or in the inguinal region. These will be made upon a suitable long probe, and it will be well in the first instance to introduce a long drainage tube from the loin incision to the counter-opening; the tube may subsequently be cut in half and shortened from each end. The wound is watched to see whether urine comes through; even if it should do so, and the case be one in which no stone has been found in the kidney, some considerable time should be allowed to elapse under proper drainage before anything further is done in the hope that, as the cavity contracts, the opening in the kidney will close. The patient must be kept in bed until the wound has completely healed. It is very difficult to give a prognosis as to the length of time required for healing, which however occurs fairly well as a rule.

It may occasionally happen that the incision fails to reveal pus; but even should this be the case, the treatment is good, as it diminishes congestion, and, should pus subsequently form, it will readily find its way through the opening. Here a large drainage tube should be inserted into the peri-nephric tissues, and the lumbar wound may be sutured round it.

SUPPURATIVE INFLAMMATIONS OF THE KIDNEY ITSELF.

Four chief conditions may be met with :

(a) **Suppurative pyelitis**, without suppuration in the kidney substance. This condition often precedes the more extensive inflammatory affections of the organ, and seldom comes under treatment as a distinct affection. It may be primary, or, much more frequently, secondary to disease of the urinary organs lower down ; inflammation spreads from the bladder along the ureter and reaches the pelvis of the kidney, to which, for some time at any rate, it remains limited.

(b) **Suppurative pyelonephritis** is much more common in surgical practice. Here there is combined suppuration in the pelvis of the kidney and in the renal tissues. Although this condition may be primary, it is more commonly secondary, and it is the chief affection included in the condition known as "surgical kidney."

(c) **Suppurative nephritis**, in which there is suppuration in the kidney itself, does not usually come into the scope of surgical practice as an entity distinct from pyelonephritis, as it is usually a part of general pyæmia. Occasionally the surgeon may be called upon to deal with an abscess of the kidney resulting from the coalescence of isolated pyæmic foci.

(d) **Pyonephrosis**.—Here there is suppuration in the pelvis of the kidney, which may be converted into a bag of pus.

We shall only describe the most common conditions that the surgeon meets with, viz., suppurative pyelonephritis and pyonephrosis ; should he be called upon to deal with a case of true suppurative pyelitis the treatment will be directed to removing the cause. The organism met with in these cases is generally the colon bacillus ; sometimes the gonococcus is the active agent, while in the more severe cases the ordinary pyogenic cocci are present either alone or in combination with the colon bacillus. When the affection is due to the colon bacillus alone it is apparently not so acute as when the pyogenic organisms are also present.

PYELONEPHRITIS.—In the great majority of cases the inflammation is ascending in character. The chief causes are obstructions to the escape of urine from the bladder, such as an enlarged prostate or stricture of the urethra, accompanied by decomposition of the urine. Another common cause is paralysis of the bladder in cases of spinal disease or injury. Occasionally it may originate from obstructions higher up, such as a calculus or a stricture in the ureter, or it may be caused by the passage of rough calculi, or the use of certain drugs, such as cantharides. It may follow the introduction of instruments, or it may originate in the kidney itself by the deposit of organisms from the blood or the lymph stream, and may spread from the kidney and its pelvis down the ureter. When the disease occurs from blood infection it is usually a part of general pyæmia and is not amenable to treatment, as both kidneys will be involved.

When the affection originates from below, one kidney alone is usually involved in the first instance, and in any case the condition is more advanced on one side than on the other. Before suppuration occurs there may be evident effects of backward pressure, such as distension of the ureter and the renal pelvis, and this diminishes the resisting power of the tissues to the micro-organisms, which gain access to the pelvis subsequently. It also facilitates the inflammation, as it keeps up a condition of renal congestion. When this condition of affairs is present, it is obvious that the introduction of micro-organisms into the bladder upon instruments is a source of the gravest danger.

The pelvis of the kidney and the ureter are in a state of chronic inflammation with much thickening, and pus is formed on their surfaces. The ureter, which may be immensely thickened, may be diminished in calibre, and is not distended, unless there be an obstruction below. There are patches of inflammation and frequently small abscesses throughout the renal cortex.

The affection may run either an acute or chronic course. In acute cases death often occurs rapidly from suppression of urine or from pyæmic or septicæmic infection. The chronic form may last for months or even years.

Symptoms.—*In the acute form* the onset of the disease is generally marked by severe rigors, with high temperature and vomiting. The patient soon passes into the typhoid state and dies in the course of two or three weeks, unless the disease be arrested. Death is often preceded by coma, with uræmic convulsions.

In the more chronic form—generally spoken of as “surgical kidney”—the onset of the affection is often insidious; the elevation of temperature is only slight at first, and the patient only complains of digestive troubles. There may be some pain or uneasiness in the loin and sleeplessness, often accompanied by slight delirium. The temperature soon becomes irregular and intermittent. Examination of the urine, which at first may be acid, but later on becomes alkaline, shows pus; in the early stages there is often polyuria and increased frequency of micturition. Albumen is present, but is usually accounted for by the pus; epithelial cells from the renal pelvis may also be made out. Later on renal casts may be present, and the kidney is very tender, but is not necessarily enlarged; when it is enlarged there is probably pyonephrosis present.

When the temperature is high at night and assumes a hectic type, and the patient rapidly loses flesh and has profuse perspirations, a quick pulse, nausea and possibly occasional rigors, it is strongly presumptive of surgical kidney if the patient be suffering from prostatic disease, stricture of the urethra, or cystitis.

It is more difficult to diagnose the affection from renal tuberculosis, but in that disease there is nothing to account for the onset of the pyelonephritis while there may be tuberculosis elsewhere, occasional hæmaturia without any obvious cause, and perhaps tubercle bacilli in the urine.

The distinction between pyelonephritis and simple pyelitis, is by no means easy to make, but the former condition generally has the severer symptoms. Many cases of pyelonephritis begin as a simple pyelitis, and the treatment is practically the same in the two conditions, unless operative treatment seems possible.

Treatment.—The possibility of the occurrence of these conditions must always be borne in mind in all cases of inflammatory disease in the lower urinary organs and in obstructions to the outflow of urine, which should, if possible, be completely and rapidly corrected. The worst cases are those of enlarged prostate or paralysis of the bladder, in which patients often die of suppurative pyelonephritis, as it is a matter of great difficulty to prevent the occurrence of sepsis in the urine. The great point is to ensure complete asepsis of any instrumental or operative interference; and, directly the urine is found to be undergoing decomposition, measures must be taken to render it aseptic. The precautions that have to be taken in operations on the lower urinary tract, and the best methods of diminishing the septic condition of the urine will be referred to in connection with diseases of the bladder and the prostate.

When inflammation of the renal pelvis or of the kidney itself has set in, the first essential is absolute quietude and rest in bed; the diet should be limited, and the urine kept well diluted. The bowels should be kept open, preferably by salines, and the diet in bad cases should be purely liquid; in less severe cases light solid food, such as fish or chicken, may be given. The ordinary diuretics are not of much value, but the slightly diuretic mineral waters, such as Contrexéville and Vichy, may be useful. The lumbar pain is best relieved by hot baths or fomentations, and in bad cases dry-cupping over the loin, or the application of leeches (see Part I., p. 5) is very advantageous. Internal antiseptics, such as salol, creosote, benzoate of ammonia, or ten-grain doses of boracic acid, seem to do good in some cases, but care must be taken to watch the effects of these drugs, as they may not only upset the stomach, but may irritate the kidney and aggravate the pain; boracic acid is particularly irritating to the stomach, and should be administered in cachets. Quinine, in doses of five grains or more three times a day, either in a pill or floating upon milk, is distinctly valuable. Other drugs are of questionable value.

The more chronic cases will derive benefit from a warm climate, where chills and congestion of the kidney are comparatively easily avoided. The condition of the bladder must always be carefully attended to, and the organ must be washed out if there be decomposition of the urine. These palliative measures often lead to marked improvement in the symptoms and, when the disease is merely pyelitis, may entirely cure it. They are practically the only measures that can be adopted in a case of surgical kidney, seeing that both organs are practically always affected, and that operation is not advisable.

A circumscribed abscess of the kidney is occasionally met with, but rarely diagnosed. Should such a thing happen, the obvious treatment is incision

with proper drainage. It may happen that an abscess of this kind is found in connection with calculi in the substance of the kidney, or the organ is cut down upon under the diagnosis of renal stone.

PYONEPHROSIS.—Here there is dilatation of the renal pelvis and calices in addition to suppuration. The condition results from some obstruction lower down the urinary passages upon which suppuration has supervened. It may arise under three different sets of circumstances: (*a*) A previously existing hydronephrosis may become infected and suppuration may occur in it; (*b*) Suppuration and dilatation commence coincidently in cases of obstruction low down in the urinary passages accompanied by an infective condition of the urine; (*c*) The pyelitis may precede the dilatation; here the distension of the pelvis is due not so much to mechanical obstruction lower down as to blocking of the ureter by pus and clot or calculi. Pyonephrosis is a not uncommon complication of renal calculus.

Causes.—The most frequent is renal calculus. The condition may arise from the pressure of tumours on the ureter, from vesical affections, such as stone, papilloma and malignant disease, or from urethral or prostatic obstructions. It is very common in tuberculous disease (see Chap. XXI.). The septic infection may be derived from the blood or the lymph stream, but more probably it is an ascending infection secondary to the dilatation.

The kidney is frequently enlarged and lobulated owing to the distension of the calices. The loculi communicate with one another and with the distended renal pelvis, whilst the renal cortex undergoes sclerosis and atrophy; the septa between the various loculi may be dense and fibrous or may be actually destroyed so that several of the sacs communicate. The interior of the pelvis is frequently lined by a phosphatic deposit.

The condition is often unilateral when it is due to renal stone, but it may be bilateral when it is due to obstruction to the outflow of urine. After a time peri-nephritis occurs, and the kidney becomes bound down to the structures in its neighbourhood. A peri-nephric abscess may occur from the spread of infective organisms through the wall of the renal pelvis into the fatty capsule without any fistulous communication, or there may be direct communication between the pelvis of the kidney and the surrounding structures. When the affection is due to a calculus, the distension of the pelvis may be intermittent; when the distension is greatest there may be no pus in the urine, but this will be followed by profuse pyuria as the distension subsides.

Symptoms.—In addition to the symptoms of pyelitis there is a tumour in the loin, and frequently profuse intermittent pyuria; the tumour is somewhat nodular and elastic. The condition of the urine varies according as the communication between the kidney and the bladder is free or not. In most cases there is a certain amount of pus in the urine; in some, the amount is large, in others the pyuria is of an intermittent type, and in them the cause is probably a stone acting as a ball-valve in the pelvis. The reaction of the

urine is usually alkaline, and there is much mucus. There is often a history of previous symptoms of renal calculus.

This condition cannot well be mistaken for hydronephrosis, in which there is no pyrexia or pyuria. It may be difficult to distinguish from a perinephric abscess accompanied by pyelitis, but the most difficult thing is to diagnose a calculous pyonephrosis from a tuberculous kidney; a skiagram may possibly clear up any doubt. One of the most helpful points in the diagnosis of pyonephrosis is the discovery of a cause of obstruction to the outflow of the urine. The lower urinary passages must be examined and stricture of the urethra, enlargement of the prostate, vesical stone, or a pelvic tumour, must be looked for. The essential points in the investigation of the condition of the kidneys themselves have been given (see p. 168); the condition of the opposite kidney is most important.

Prognosis.—This depends on the cause of the distension and the possibility of its removal, and also upon the condition of the opposite kidney. If the latter be healthy and the cause of distension be removable, as, for instance, when the cause is due to stone, the prognosis is good; if the cause be irremovable or the other kidney be affected it is very gloomy.

Treatment. (a) **Palliative.**—When the condition is not urgent enough to demand immediate operation, or while the case is being thoroughly examined in order to ascertain the exact cause of the mischief and the condition of the opposite kidney, general treatment, such as that already recommended for pyelonephritis, should be employed (see p. 209). Moreover, this should be persisted in whilst any obstructive condition in the lower urinary passages is being attended to.

When the condition has been ascertained to be due to some mischief in the kidney, such as a stone, or when obstructive conditions lower down in the urinary organs have been rectified without improvement in the renal condition, the question of dealing directly with the kidney, if only one be affected, will naturally arise. Time should not be wasted on palliative measures if they do not produce improvement, especially when there is much pyrexia.

(b) **Operative.**—This takes the form either of simple nephrotomy and drainage, or nephrectomy. The object of the operation is twofold; in the first place the pus requires evacuation, and the abscess must be drained, and in the second place the obstructing cause must be removed if possible. Hence, the first thing to be done is a nephrotomy, and the question of nephrectomy will only arise under certain circumstances. Nephrectomy may be either primary or secondary.

Nephrotomy.—The kidney is exposed in the usual manner, as for nephrolithotomy (see p. 227), isolated and brought as far up out of the wound as possible; when there is not much condensation of the peri-nephric fat, it may be brought entirely out on the loin. It is palpated in order to detect any cause of obstruction, such as a stone, and, before opening the kidney, it is well to isolate and palpate the ureter as far down as possible. Should peri-renal

adhesions prevent the organ being brought out on to the loin, the tissues around must be packed off before the kidney is opened. The kidney should be incised freely a little behind its convex border, so as to split the organ well open; the pus is washed away as it escapes with a strong stream of normal saline, or sublimate (1-4000) solution. The finger is introduced into the pelvis, and if a stone be found it is removed (see Chap. XXII.). If no stone be found, a probe is passed down the ureter, and an impacted stone or a stricture is searched for and dealt with appropriately.

After the kidney has been opened and any obstruction removed, drainage should be employed if a fair amount of healthy renal tissue be left. A large tube (No. 24) is passed well into the pelvis of the kidney and fixed there, the original packing is removed and a little fresh gauze is tucked in around the tube. When the kidney has been brought out on the loin, it is well to fix it to the abdominal wall by two or three stitches,¹ as otherwise the organ might fall away from the drainage tube, which would, therefore, not act properly. When there are dense peri-nephric adhesions however this is not likely to occur. The lumbar wound is left open. When a peri-nephric abscess is present in addition to a pyonephrosis, a tube should be passed behind the kidney as well as one into the pelvis.

After-treatment.—The dressing requires frequent renewal, because there will be free escape of urine through the loin as well as pus. If the cause of obstruction has been removed and there is no obstruction in the ureter, rapid improvement generally follows, the urine escaping partially through the loin and partially into the bladder, the amount passing in the former direction diminishing fairly rapidly. As soon as urine passes freely into the bladder and the amount of pus diminishes, the drainage tube may gradually be shortened. Even in favourable cases however it will be something like three or four weeks before this can be done safely, and after that a renal fistula may remain for several months. Should this not close at the end of six or eight months, the case must be looked upon as one of permanent renal fistula, and treated accordingly (see Chap. XXII.). The patient should be kept in bed for the first six or eight weeks, but, if at the end of that time the temperature has fallen and the patient's condition has improved, he may be allowed to get up wearing a suitable lumbar urinal. It will generally be necessary to use a drainage tube corresponding in length to the thickness of the abdominal wall as long as the fistula persists, in order to keep the external opening patent.

Nephrectomy.—Sometimes however it is obviously hopeless to expect nephrotomy and drainage to effect a cure, and a primary nephrectomy may therefore be called for. This will be necessary, for example, when there is a cicatricial stricture of the ureter which cannot be overcome, so that nephrotomy and drainage will certainly end in a permanent renal fistula. Moreover the kidney may be so disorganised that little or no secreting substance is left and it is clear that the organ is functionally useless. Whenever this is the case,

¹ These should be made to emerge through the skin in order that they may be removed later on.

and there is reason to believe that the other kidney is healthy, primary nephrectomy is indicated, but undoubtedly the proper treatment in the majority of cases, in the first instance at any rate, is nephrotomy and drainage, which has the advantage that, even should subsequent nephrectomy become necessary, the condition of the other kidney may be inferred from the characters of the urine passing through the bladder, as the secretion from the affected kidney will probably all pass through the loin in the first instance, and the two may thus be differentiated. Of course should the opposite kidney be markedly affected also, the patient must put up with a permanent renal fistula.

The operation is the same as that for renal calculus (see Chap. XXII.). A secondary nephrectomy is undoubtedly more difficult than a primary one, as there probably will be extensive adhesions to surrounding parts; this makes it more imperative to operate by the lumbar route. The trans-peritoneal operation ought not to be employed, because it is not only more difficult to separate the adhesions on the posterior surface of the kidney, but infection of the peritoneum is almost certain to result. Great difficulty may be met with in dealing with the renal pedicle, on account of shrinkage and adhesions. In any case the ureter should be isolated separately, and it should be brought out into the lower angle of the wound after division, the cut surface swabbed with undiluted carbolic acid, and either stitched into the wound, or invaginated and sutured. If the matting of the structures in the hilum of the kidney be very extensive, it may be necessary to put a temporary ligature round the pedicle, to cut the kidney away in front of this, and then to clear and tie the vessels separately. The wound should be flushed out frequently during the operation, as otherwise there will be extensive sepsis, and in any case free drainage must be employed. The after-treatment is the same as that for nephrectomy for stone (see Chap. XXII.).

CHAPTER XXI.

TUBERCULOSIS OF THE KIDNEY AND URETER.

THE kidney is one of the commonest seats of genito-urinary tuberculosis, and the disease in it may be primary or secondary to a similar affection elsewhere. In primary renal tuberculosis the organisms reach the part through the circulation, and the affection may be localised or there may be a general tuberculosis of both kidneys, together with similar disease elsewhere. When tuberculosis attacks the kidney primarily it generally commences in the cortex, whereas the secondary form is an ascending affection and begins in the renal pelvis. It is most common between the ages of twenty and thirty, and seems to be more frequent in women than in men. The affection may be limited to one kidney, and this seems to occur in about 50% of the cases. When both sides are affected, the disease is usually much more advanced on one side than on the other. It is predisposed to by previous renal affections, such as nephritis or pyelitis, or by blows on the loin, alcoholism, etc. The tubercles are deposited about the bases of the papillæ, and spread both towards the capsule and towards the pelvis. The tuberculous masses soften, forming cavities containing cheesy material, which after a time burst and discharge their contents into the pelvis and thence down the ureter. When this happens, the mucous membrane of the renal pelvis becomes the seat of tuberculous disease, and thus there is a typical tuberculous pyelonephritis, and often pyonephrosis also. As the disease advances, the kidney becomes progressively disorganised, until finally it consists of a series of cavities containing cheesy material.

The affection spreads from the kidney to the ureter, which may become markedly thickened and diminished in calibre from the deposit of tubercles in its walls; this leads to interference with the outflow of the urine. Calcareous masses are often deposited on the cheesy material in the renal pelvis and become renal calculi, so that a combination of tuberculosis with a calculous condition is not infrequent. The capsule becomes thickened and adherent, and peri-nephritis occurs and firmly fixes the kidney—an

important point in operating, as the pedicle may be much shortened, and the vena cava may lie close beside the organ, and may be injured in doing nephrectomy.

Symptoms.—These vary according to the stage of the disease and its mode of onset. In primary infection from the blood-stream there are practically no symptoms in the very early stages. The first signs are pain in the loins—usually moderate in amount and not much influenced by movement—frequent micturition, and polyuria, together with some diminution in the amount of urea and phosphates. An early symptom is also hæmaturia which may occasionally be severe and prolonged but which is generally small in amount, often requiring microscopical examination for its detection. It appears without apparent cause and is not increased by movement or improved by rest.

As the affection progresses, the pain in the loin becomes severe and of a lancinating or boring character. There are exacerbations, probably due to the passage of small caseous masses along the ureter, and occasionally there may be a sort of intermittent hydronephrosis from blockage in this manner. The kidney becomes tender and is generally enlarged; in some cases this is the first symptom noticed. The organ may retain its normal outline but it more often has a lobulated feel. As the disease advances, the urine contains quantities of pus, some blood and often *débris* and cheesy particles; when there is a mixed infection the amount of pus may be very large. Sometimes there is albuminuria out of proportion to the amount of pus, which indicates the existence of a chronic nephritis or of waxy degeneration. The tubercle bacillus may be found in the urine under the microscope after centrifugalisation, or, in doubtful cases, after inoculating guinea-pigs. Sometimes there is marked dysuria, which may lead to an erroneous diagnosis of disease of the bladder. It is however not uncommon to get a chronic non-tuberculous cystitis set up by the passage of the tuberculous material and pus through the organ; there may also be co-existing tuberculous disease of the bladder. When the urcter is much thickened it may be felt through the abdominal walls in a thin patient, or the lower end may be felt through the vagina in the female. In the early stages the patient's general health remains fairly good, but later on there is loss of flesh, accompanied by hectic fever and night sweats and there may be marked toxic symptoms, such as anorexia and vomiting, and finally symptoms of septicæmia or pyæmia. The more severe symptoms are probably due to secondary pyogenic infection rather than to the tuberculous disease itself.

The diagnosis in the early stages may be extremely difficult. Should the tubercle bacillus be found in the urine, the nature of the disease is certain; but in its absence the frequent micturition and the pain in the loin, both of which are unaffected by rest, together with the presence of pus and blood in acid urine, hectic fever, progressive loss of flesh, enlargement of the kidney, and possibly tuberculosis elsewhere, will generally lead to a correct diagnosis. The hæmaturia of renal tuberculosis is not likely to be

confounded with that of stone, as it is much slighter in degree and is quite uninfluenced by movement ; nor should it be confounded with that due to a renal growth, which, although equally unaffected by movement, is generally profuse.

Important points which have to be investigated before deciding upon treatment are which kidney is affected and whether the other kidney is healthy ; these questions have already been discussed (see p. 171).

TREATMENT.—This may be either non-operative or operative.

(a) **Non-operative.**—This is mainly the ordinary treatment of tuberculosis (see Part I., p. 245). Among special drugs creosote (15 to 20 minims three times a day) and iodoform (in one-grain pills) are most useful.

(b) **Operative.**—From the very earliest period the question of operative interference must be carefully considered. If time be lost, the bladder or the other kidney may become affected.

The surgical procedures available are as follows :

(a) Nephrotomy followed by drainage of the pelvis of the kidney, with removal of as much of the tuberculous material as possible. This may be the only method adopted or, when the patient is not in a condition to stand a primary removal of the organ, it may be a preliminary to a secondary nephrectomy.

(b) Partial nephrectomy, in which only the diseased portion of the kidney is removed.

(c) Complete nephrectomy, accompanied by removal of as much of the ureter as is diseased.

The choice between these procedures will depend essentially on whether the other kidney is healthy, on whether the bladder is unaffected, and on the general condition of the patient.

Nephrotomy.—Nephrotomy is indicated when the patient is so bad that something must be done but is so weak that nephrectomy is out of the question ; when the other kidney is so extensively affected, that the removal of even a small amount of secreting kidney tissue is not justifiable ; or when there is marked vesical tuberculosis, for here the symptoms will not be materially relieved by nephrectomy, and moreover, the other kidney will almost inevitably become affected before long. Another indication is the co-existence of a peri-renal abscess with the disease in the kidney.

Nephrotomy is done as for pyonephrosis (see p. 211). The caseous material is scraped and flushed out freely (see Part I., p. 249), and a large drain is introduced, the kidney being sutured to the edges of the lumbar incision. A good plan is to make the assistant compress the ureter, and then to irrigate the kidney first with 1-500 sublimate solution, and then with boracic lotion, to get rid of the strong antiseptic. Considerable improvement may follow this method and, when the kidney operated upon is the sole seat of disease, nephrectomy may be performed subsequently, for simple nephrotomy practically never leads to a cure, nor can it be depended upon to prevent the spread of the disease, because pus and urine will still escape into the bladder.

In some cases shrinking of the organ and quiescence of the disease may ensue, but the best that can be hoped for from it is relief of the hectic fever and the other symptoms due to the retention of decomposing pus.

Partial nephrectomy.—When the kidney has been cut down upon and the tuberculous lesion is found to be limited and not to involve the pelvis of the organ, the affected portion of the kidney has been excised in several instances and the remainder left. This is done by the removal of a wedge-shaped portion, the cut surfaces being approximated by deep sutures (see p. 191). In some instances benefit has followed, although in several it has been found necessary to remove the kidney subsequently. The possibility of this procedure must be kept in mind when a tuberculous kidney is exposed, for, if it be practicable to remove the disease and to leave a sufficient amount of useful kidney tissue behind, the great objection to nephrectomy is removed.

Complete nephrectomy.—This is the ideal operation, but the other kidney must be sound before its employment is justified; the bladder and the peri-renal tissues must also be free from disease, and the patient in a fair condition to stand the operation. These questions have already been gone into sufficiently fully (see p. 171). The most difficult point is the accurate determination of the condition of the opposite kidney, and for this reason many surgeons have urged that nephrectomy for tuberculous disease should be done by the abdominal route, as the hand can then be passed to the opposite side, and the condition of the kidney ascertained by palpation. Other surgeons again while admitting that the lumbar operation is preferable for the removal of the organ, suggest that before it is done an exploratory laparotomy should be made, and both kidneys carefully palpated. No doubt a kidney that is nodular and hard and associated with other symptoms of tuberculosis may safely be pronounced to be tuberculous, but, on the other hand, it does not at all follow that, because a kidney is smooth and of normal size, it is not tuberculous; nor again does it follow that an enlarged organ is necessarily tuberculous. It has happened more than once that a kidney suspected to be tuberculous has been found not to be enlarged or even to be smaller than normal when cut down upon, while the kidney on the opposite side is markedly enlarged, and further investigation has shown that the small organ is the tuberculous one, whilst the enlarged one is simply a healthy kidney which has undergone compensatory hypertrophy. The only satisfactory way is to cut down on the organ in the loin (see also p. 170). The objection to this is that it means extra shock which the patient cannot always bear, and in a good many cases, therefore, the matter must be left in some doubt, and the patient must be allowed to take his chance. This is quite justifiable when the suffering is severe and one kidney is hopelessly disorganised, and statistics show that the result is generally satisfactory.

The operation may be primary or it may be secondary to a previous nephrotomy. It is easier and more likely to be beneficial when performed

as a primary operation, but, as we have said, the patient's condition sometimes negatives anything more serious than nephrotomy and drainage on the first occasion. Secondary nephrectomy is rendered difficult and prolonged by the adhesions that are present, and there is therefore considerably more shock and loss of blood, and the surgeon may find the technique of the operation much more difficult as the vessels may have become displaced by the inflammatory condition around the kidney. In some cases indeed it has been found necessary to remove the organ piecemeal, but this should always be avoided if possible. The operation is described elsewhere (see Chap. XXII.).

Nephrectomy for tuberculosis should always be done by the lumbar route. It is very difficult to remove a large tuberculous kidney without pus escaping at some period of the operation and, should this occur within the peritoneum, the risk of septic peritonitis is very great. The lumbar incision gives plenty of room for the removal of any tuberculous kidney likely to require it. The ureter is probably diseased also and should therefore not be ligatured with the pedicle, but should be isolated and traced downwards as far as possible before the rest of the pedicle is ligatured and divided. After this has been done and the kidney has been brought out of the wound, the condition of the ureter is carefully examined and the tube is traced down until a healthy portion is reached, even if the wound has to be extended for the purpose, and then it should be ligatured in two places and divided between. Before division, gauze should be packed around so as to prevent infection by any pus present between the ligatures. It is for the purpose of avoiding infection that the kidney and ureter are isolated as one structure in this manner, and that everything else is done before they are separated. If the divided distal end of the ureter be apparently healthy, its lumen should be scraped out and touched with undiluted carbolic acid and the end may then be turned in and secured by catgut stitches. Should there be evidence of tuberculous mischief lower down however, the remainder of the tube must be dissected out, either at the time or at a subsequent operation, according to the patient's condition. The operation of ureterectomy is described below.

If the patient be suffering severely from shock, the ends of the ligature upon the distal portion of the ureter should be left long and brought out of the wound, the upper portion of which should be closed, and then, three or four days later, when the patient has recovered from the shock, the remainder of the ureter may be dissected out; the ends of the ligature will act as a guide to the tube. It is always well to remove a markedly diseased ureter even though this may involve a second operation, as otherwise a permanent fistula is almost certain to occur in the loin, and the disease is also apt to infect the bladder and so to spread down the genito-urinary apparatus. On the other hand, when the disease is only very slight, the tubercles may undergo atrophy and disappear when urine no longer passes through the ureter.

The majority of these cases do well after operation, both immediately and ultimately. The mortality is variably given by different writers. Some have had very few deaths at all. In others the mortality is as high as 29 per cent. ;

this seems to us however excessive. Death is brought about by shock, septicæmia, or generalisation of the tuberculosis.

It will be well here to say a few words concerning removal of the ureter, or ureterectomy, as an operation apart from removal of the kidney, although as a matter of practice it is nearly always done simply as a continuation of a nephrectomy. Occasionally however the ureter may have to be removed subsequently, or it may have to be exposed independently.

Ureterectomy.—As we have already said, tuberculosis of the ureter is nearly always secondary to similar disease in the kidney, but it may be secondary to tuberculous disease of the bladder and, more rarely still, the ureter may be the seat of a growth or a localised dilatation owing to obstruction. Primary tuberculous disease of the ureter is practically unknown, and the affection of the tube itself gives rise to few or no symptoms apart from those due to the primary mischief from which it originates. Occasionally, when the patient is very thin or the ureter is very much dilated, it may be possible to feel its thickened walls through the abdomen. In the female the lower end may be felt through the vagina.

In order to remove the ureter completely down to its insertion into the bladder several methods are employed. The peritoneal route has been adopted by some, the abdomen being opened while the patient is in the Trendelenburg position, and the peritoneum being divided over the ureter and the latter removed. While this however may be a possible route in cases of ureterotomy for stone, it is not advisable for the excision of a tuberculous ureter, for which one of the three following routes should be chosen, viz., the lumbo-ilio-inguinal, the sacral, or the vaginal route in females. The perineal route has been employed in the male, but is of very limited application. In practice the routes chosen are generally either the lumbo-ilio-inguinal or the sacral.

The lumbo-ilio-inguinal incision (see Fig. 49) commences below the last rib near the edge of the erector spinæ, as for lumbar nephrectomy (see p. 230), and is prolonged downwards and forwards in front of the anterior superior iliac spine, and about an inch internal to it, running parallel to Poupart's ligament and about two inches above it, down to its centre or even as far as the external abdominal ring. By it the greater part of the ureter can be exposed, except where it lies immediately behind the bladder. When the operation is done, as it usually is, in connection with nephrectomy, the upper part of the incision is already made, and it only needs to be prolonged downwards for the ureterectomy. If the operation be performed at a later date as a second stage of



FIG. 49.—MORRIS'S LUMBO-ILIO-INGUINAL INCISION FOR REMOVAL OF THE KIDNEY AND URETER.

nephrectomy, it is not necessary to open up the nephrectomy wound ; all that is required is to continue it downwards from its lowest point in the direction mentioned above. In practice it will be found well not to carry the incision to its full length at once, but to lengthen it in the desired direction as may be necessary. The skin, the fascia, the three abdominal muscles and their aponeuroses, and the transversalis fascia, are exposed and divided in turn. When the sub-peritoneal fat comes into view, the peritoneum is carefully lifted up with the fingers and dragged upwards and towards the middle line, as in the operation for tying the external and common iliac arteries (see Part II., p. 349). In the upper part of the wound the ureter may easily be stripped forward with the peritoneum, and care must be taken that the assistant's fingers do not hide it from view. A smooth, flat sponge, should be placed between the hand and the peritoneum, and serves as a useful support. The patient, who will be lying in the ordinary position for nephrectomy (see p. 230), should be rolled over to some extent on to the back when the ureter is to be exposed. When the kidney has been removed previously, the ligature around the divided end of the ureter will lead to the identification of the tube at once. In other cases it is found as a whitish or yellowish-white tape-like structure or, when full of tuberculous contents, as a rigid cord. It is generally found as it crosses the iliac vessels which are a guide to it. When the ureter has been defined, the sheath of cellular tissue attaching it to the peritoneum should be gently torn through, and the latter structure pushed forward ; by a little traction it is easy to isolate the ureter downwards.

In the female the ureter lies behind the broad ligament, and is not easily exposed in this manner, and if it has to be traced lower down than the brim of the pelvis, the uterine artery and veins must be divided. When the ureter has been isolated as low as possible it should be divided between two ligatures. If it be then decided not to remove the entire length, the divided end should be rubbed with undiluted carbolic acid or iodoform paste, and the walls invaginated and sutured by Lembert's method. The whole wound may then be stitched up without a drainage tube.

Various accidents may happen in this operation. For instance, the peritoneum may be torn, in which case the rent must be sutured before proceeding further. Some of the nerves of the lumbar plexus may be mistaken for the ureter, but they may be distinguished by the fact that the ureter is raised with the peritoneum whilst the nerves remain. In isolating the ureter the separation must be kept close to its walls, as otherwise the peritoneum may be injured, or the spermatic, the ovarian, or the uterine arteries and veins may be torn. Occasionally the ureter is torn or punctured in the operation and, should pus escape into the wound, care must be taken to flush it out thoroughly, and drainage should be employed.

Removal of the termination of the ureter, which is however seldom necessary in these cases, must be effected by another route, preferably the sacral. The incision is much the same as that in Kraske's operation for cancer of the rectum (see p. 77). After the rectum has been exposed,

the peritoneum is defined in front of it, and gradually separated forwards until the posterior wall of the bladder is reached, when the ureter is identified, adherent as usual to the under surface of the peritoneum. The patient should be turned on the sound side, so that the rectum falls away from the region operated upon and the pelvis should be well raised so as to carry the parts somewhat upwards. The ureter is carefully isolated both from the peritoneum and the base of the bladder, divided between ligatures as before, the open end treated as described above, and the wound sutured after providing for drainage in case of infection, owing to the near neighbourhood of the anus.

In females the operation is more difficult on account of the broad ligament, and some surgeons have recommended resection of the sacrum, in order to give more room. This is done as for Kraske's operation (see p. 77). The vaginal route is not to be recommended for a tuberculous ureter, although it may be employed for an impacted stone (see p. 235).

CHAPTER XXII.

RENAL AND URETERAL CALCULUS: SUPPRESSION OF URINE: RENAL FISTULA.

RENAL CALCULUS.

RENAL calculi may be formed in the uriniferous tubules, in the calices or in the renal pelvis. The commonest form is that consisting of uric acid; next in order of frequency come those of oxalate of lime, then those consisting of urates and, much more rarely, of phosphate or carbonate of lime, cystine or xanthic oxide. The so-called "secondary calculi" which are deposited in a kidney that is the seat of some disease, are usually composed of phosphates and carbonate of lime. The nucleus of the calculus may be crystalline or it may be formed of blood-clot, mucus or caseous material. When septic changes occur in the urine, alkaline phosphates are deposited and form an outer coating to a primary calculus.

The calculi may be multiple or single; oxalate of lime stones are generally single. They may be rough or smooth, roundish or oval, or they may be branched and correspond to the calices of the kidney. The stone may be movable or fixed; massive branched calculi are usually fixed, whereas the small round ones may move freely in the renal pelvis, and cause obstruction from time to time by falling over the orifice of the ureter. Calculi are sometimes imbedded in the renal parenchyma.

Calculi may occur simultaneously in both kidneys or in one organ after the other; they are equally often present on one side only. They are not common between twenty and forty years of age, and are quite rare in children. A sedentary life, debility, the use of hard drinking-water, an excess of nitrogenous food, occasionally an excess of vegetable diet, inflammatory conditions of the renal pelvis or septic conditions of the urine in the case of phosphatic calculi are amongst the chief causes. They are said to occur more often in dyspeptics and neurasthenics, and are more common in males than in females.

A renal stone must either be got rid of by passing along the ureter into the bladder or by a surgical operation, as no attempt to dissolve a fully-formed

calculus seems to be successful. The stone does damage in several ways. It sets up a chronic nephritis which diminishes the secreting power of the organ, and the irritation may extend to the capsule and give rise to perinephritis with adhesions, or later on to perinephric suppuration. When in the pelvis of the kidney, the stone may block the ureter and give rise to distension of the pelvis and calices. Occasionally true hydronephrosis results, but this is rare as the blockage of the ureter is usually temporary. A stone may pass into the ureter and block it completely, when it gives rise to distension of the pelvis, and in some cases to complete suppression of urine from reflex action both on the same and on the opposite side.

After a time sepsis generally occurs and there is suppurative pyelitis or pyelonephritis or sometimes pyonephrosis, and consequently more rapid destruction of the organ. A kidney that has long been the seat of stone may be converted into a mere bag of pus containing one or more stones. When suppuration has taken place in the kidney, perinephric abscess is likely to follow, and there may be a fistulous opening in the loin, while occasionally the stone escapes into the peri-renal tissues and is found in the abscess. The prognosis of renal calculus is therefore very serious and, as a rule, the sooner measures are taken to remove a stone the better it is for the patient.

SYMPTOMS.—The classical symptoms of uncomplicated cases of renal calculus are pain and hæmaturia. The *pain* is fixed and persistent, and is either a dull aching in the affected loin or severe pain causing the patient to keep the affected side rigid on stooping or moving; it is aggravated by exercise, and generally improves on lying down. When there is much pain there is also, as a rule, tenderness on pressure over the affected kidney, with reflected pain down the ureter and into the thigh and testicle on the affected side. The pain may be occasionally referred to the bladder and give rise to frequent and painful micturition which may lead to a mistaken diagnosis of vesical calculus.

One of the commonest symptoms of calculus is *renal colic*. A small stone may escape along the ureter without causing very much trouble, while if large it may remain in the kidney without giving rise to symptoms; but stones of intermediate size pass into the ureter and there give rise to a series of symptoms known as renal colic, which is due to the attempts of the ureter to expel the stone. True renal colic is nearly always due to the passage of a calculus, but it may occasionally arise from the passage of a clot along the ureter, or even from kinking of that structure in cases of movable kidney. Typical renal colic is a sudden attack of violent pain shooting down the branches of the lumbar plexus and felt in the bladder, the groin and the testicle on the affected side. It is paroxysmal and often excruciating, so that the patient screams and is doubled up by it. There is retraction of the testicle which may afterwards become enlarged and tender. The attack may be ushered in by a rigor, and is generally accompanied by vomiting and retching, with faintness and collapse. The urine is diminished in quantity and may be blood-stained and loaded with urates, and often give rise to

scalding. The bladder is irritable and the urine is passed frequently. In some cases there is a high temperature and great mental prostration, whilst the kidney and ureter are both tender on palpation. Suppression of urine may actually occur, due either to blockage of both ureters by stones, or to reflex action caused by the presence of a stone on one side. The attack frequently passes off quite suddenly when the stone reaches the bladder; on the other hand, the calculus may become impacted in the ureter, and then the acute pain passes off and leaves a dull aching in the region of the kidney or the ureter. Sometimes the stone may slip back again into the renal pelvis. The treatment of the actual attack of renal colic is described separately (see p. 232).

Hæmaturia is frequently but by no means constantly present. It is comparatively slight in amount, and the blood is intimately mixed with the urine, while occasionally clots are passed, moulded in the ureter or the renal pelvis. The bleeding is aggravated by movement, and diminished by rest.

Pus is generally found in the urine under the microscope, and the pyuria may be very considerable when there is a suppurative infection of the renal pelvis. The urine as a rule is acid and not offensive, except when there is severe pyelitis. Albuminuria is nearly always met with, but is usually accounted for by the pus present. There is enlargement of the kidney, ascertainable by palpation in a certain number of cases, especially in the later stages when there is suppuration in the renal pelvis.

The *diagnosis* of stone in the kidney is not always easy. The pain may be confounded with that due to lumbar neuralgia, but in the latter case there is usually an entire absence of tenderness over the kidney. Biliary calculi may co-exist with renal stones. Neuralgia of the kidney is often present when the organ is movable; but in the latter case the absence of any hæmaturia, and the mobility of the organ will usually clear up the diagnosis. Intermittent hydronephrosis may be mistaken for renal colic, and so may appendicitis, especially the type known as appendicular colic. A condition most difficult to diagnose from renal calculus is renal tuberculosis (see p. 215), more especially as deposit of phosphates takes place upon the caseous material in some of the latter cases, so that a stone is actually present.

A growth of the kidney is usually distinguished from renal calculus by the entire absence of a history of colic, and by the fact that the hæmaturia is not only very profuse but is apparently causeless, and is not improved by rest, while the increasing size of the tumour will soon clear up the diagnosis. Renal embolism from heart disease has also given rise to difficulty in diagnosis. Paroxysmal renal pain of unknown origin may closely simulate renal calculus, and the kidney has been exposed a number of times for this condition, and nothing found. Renal neuralgia accompanied by hæmaturia, may be due to malarial poisoning, and is a source of great difficulty in diagnosis. Examination of the blood, and a

consideration of the temperature and the history of the patient should however lead to a correct diagnosis.

When a patient suffers from gravel, that is to say the passage of small crystals down the ureter, all the symptoms of renal calculus may be met with. Here the prophylactic treatment, by which operative interference is generally preceded, will clear up the diagnosis, as the condition subsides entirely.

At the present time some help may be gained by means of the X-rays. It must be remembered however that different forms of stone vary in penetrability. For example, a uric acid stone only gives a faint shadow whilst the oxalates give a well-marked one. In very stout patients the thickness of the tissues may also interfere with a satisfactory result. A good plan in taking these photographs is to make the exposure only after deep inspiration. The patient fills his chest and holds his breath, and the exposure is made; the rays are then shut off whilst the patient empties his chest and fills it again, when they are again turned on. In a considerable number of cases an obscure diagnosis has been satisfactorily cleared up by means of the rays. In employing them it is well to take photographs on different occasions in order to see whether a constant result is obtained, as the shadows cast by the stones are frequently so faint as not to be characteristic, and imperfections in the plate, etc., may easily give rise to appearances which, if only a single photograph be taken, may be mistaken for a stone.¹

In cases of renal calculus, as in those of tuberculosis, an important point is the determination of the condition of the opposite kidney, and in renal calculus moreover it is obviously very important to know upon which side the stone lies. It is said that occasionally the pain due to a renal calculus is referred to the healthy kidney, and not to the side upon which the stone lies, but this must be extremely rare, and in practice one is almost safe in deciding that the mischief lies upon the side to which the pain, tenderness, and attacks of renal colic are referred. The question of the condition of the opposite kidney, although of importance, does not interfere with the question of operative interference for the removal of the stone; indeed it rather adds to the urgency of the operation. The circumstances under which the condition of the second kidney is most important are when, on performing nephrolithotomy, the affected kidney is found to be disorganised, and to require removal. This point has already been discussed (see p. 170).

TREATMENT. (a) **Preventive.**—The surgeon is often asked by patients who have had attacks of renal colic followed by the passage of small

¹ We have had a most interesting case in which greasy material, presumably a metallic ointment upon the parchment of the table, caused shadows which might easily have been mistaken for stones if this precaution had not been adopted. This is a point that it is always well to bear in mind. Considerable practical experience is necessary to obtain satisfactory results on account of the variation in the penetrability of the different kinds of stone

calculi, but in whom there is no evidence of the presence of a stone, what they can do to prevent the formation of a fresh calculus.

The preventive treatment of stone is largely hygienic and dietetic. A due amount of exercise, such as bicycling, horse riding or walking, should be prescribed, and the action of the skin should be promoted both by friction and by the occasional use of a Turkish bath. In the diet, excess of nitrogenous food, both vegetable and animal, must be avoided and only the white meats should be allowed. Alcohol in any large quantity should be forbidden; with the exception of a little whisky and water it is best avoided altogether. When the urine contains an excess of urates, alkaline diuretics are of considerable service; bicarbonate of potash or soda, citrate of potash or lithia, benzoate of ammonium or acetate of potash may be prescribed.¹ Urotropine is said to be a solvent of uric acid as well as an antiseptic and a diuretic and may be given in ten-grain doses; cystamine in five-grain doses is a good substitute. The mineral waters of Vichy, Royat, or Contrexéville are also much in favour, and the patient may with advantage spend some weeks each year at one of these watering-places. It is important that the bowels should be regulated.

When there is an excess of phosphates—phosphaturia—this treatment is not efficacious. Any alkaline dyspepsia present must be corrected. A generous diet, and the treatment for neurasthenia should be adopted. If the phosphaturia be due to pyelitis, this must be suitably treated (see p. 209). Mineral acids, strychnine, bitter infusions, quinine and preparations of iron are the most useful drugs: antiseptics, such as urotropine, salol and boracic acid in ten-grain doses thrice daily may be called for when there is decomposition of the urine.

In the oxalic acid diathesis, fresh air and exercise are of great importance. Vegetables rich in oxalic acid, such as asparagus, tomatoes, rhubarb, or gooseberries should be avoided. Plenty of diluents are also indicated, while stimulants are sometimes of value. Nitro-hydrochloric acid, bitter infusions, strychnine, quinine and preparations of iron are all of value. Contrexéville and other waters containing lime are to be avoided.

(b) **Palliative.**—The above measures are also of value when small calculi are present and should be employed, according to the condition present, as a preliminary to more radical surgical treatment. It undoubtedly does sometimes happen that a course of medical treatment causes the symptoms to disappear and averts an operation. Although probably in most of these cases the condition is one of gravel rather than of actual stone, it may happen nevertheless that a small stone may have its surface rounded off and may thus

¹When there is a persistent excess of urates in the urine, the late Sir William Roberts recommended attempting the solution of a calculus in the kidney, but there is no real evidence that any true solvent action is ever exerted upon an actually existing calculus. His plan, which may be very useful in cases of "gravel," consists in administering citrate of potash in large doses. It is prepared freshly by adding twelve drachms of bicarbonate of potash to eight and a half drachms of citric acid in twelve ounces of water: this will yield sixty grains of citrate of potash to the ounce, and an ounce may be given every three or four hours during the day.

pass more readily down the ureter. When the diagnosis is clear however, operation must not be delayed in the hope that the stone will be passed thus because in the meantime the kidney may become seriously damaged.

(c) **Operative.**—When the symptoms point to the existence of a stone too large to pass down the ureter, surgical intervention should be undertaken in order to prevent disorganisation of the kidney. The surgeon has the choice between two methods, viz., (a) Extraction of the stone, *i.e.* nephro-lithotomy; and (b) Removal of the kidney together with the stone, *i.e.* nephrectomy.

Nephro-lithotomy is the ideal operation for all cases of stone and it is only when the surgeon finds during the course of the operation that it will manifestly not meet the requirements of the case that nephrectomy should be resorted to. A disorganised kidney which is a mere abscess cavity devoid of renal structure clearly requires nephrectomy, as a nephro-lithotomy would probably give rise to a permanent fistula, and the patient would also run risks from sepsis. Nephrectomy must also be done if the ureter be occluded and there be no chance of restoring its lumen; these cases however are rare. For the above conditions, the operation will be a primary nephrectomy, but a secondary nephrectomy may be called for when a permanent lumbar fistula is left after a nephro-lithotomy and the other kidney is evidently healthy; the patient will probably insist on the affected kidney being removed because of the inconvenience it causes. In all other cases nephro-lithotomy is the operation of choice and it must be the operation of necessity when the opposite kidney is known or suspected to contain calculi or is markedly diseased, and where it is most important to restore one kidney to health as soon as possible and nephrectomy cannot be done on account of the condition of the other.

Nephro-lithotomy.—The preparation and position of the patient are the same as for nephropexy (see p. 178). The incision corresponds to the upper part of the “lumbo-ilio-inguinal incision” (see Fig. 49); it commences just internal to the outer edge of the erector spinæ, runs parallel to and nearly an inch below the lower border of the last rib, and should extend nearly to the level of the anterior superior iliac spine whence it can be easily prolonged downwards if a stone be found in the ureter (see p. 234). The muscles should be cleanly divided, as it is seldom possible to get satisfactory room by simply splitting them. It is well however not to divide structures too freely until the condition of the kidney has been ascertained; then the parts can be opened up as widely as may be necessary. Additional room is rarely required in these cases, but it may be wanted when nephrectomy has to be done at the end of the operation or when the patient is very fat, and it may be obtained by carrying a vertical incision upwards over the twelfth rib¹

¹ As Morris remarks, this will not often be required if the vertebro-costal ligament of Henlé be divided beneath the last rib by a probe-pointed bistoury. This ligament is derived from the anterior layer of the transversalis aponeurosis, and runs from the tips of the first and second lumbar transverse processes to the twelfth rib, or to the eleventh when the former is rudimentary.

from about the centre of the oblique one. Excision of the last rib may also be required in a few cases, and the outer edge of an unduly broad quadratus lumborum may require nicking; in rare cases even the sheath of the erector spinæ itself may have to be treated thus. The last dorsal and the ilio-hypogastric nerves should be avoided if possible but, if they must be divided, a portion should be excised in order to prevent the ends being caught in the cicatrix.

The fatty capsule of the kidney is exposed exactly as in nephropexy (see p. 178). The assistant makes firm pressure from the front, and, after full retraction of the edges of the wound, the kidney is completely freed from the surrounding structures, so that it can be extruded from the wound. The organ should be cleared first below, and the separation is carried forwards until the ureter is reached, when a sponge may be pushed into the wound and made to compress the ureter against the loin and so prevent the escape of a calculus from the renal pelvis. If possible, the kidney should always be got out on the loin, as it enables it to be much more thoroughly examined, and the removal of a stone is thereby greatly facilitated. This however may be impossible in many cases owing to extensive peri-nephritis, and the structures in the hilum may have undergone so much shrinkage as to render traction upon the pedicle dangerous. If the organ cannot be brought out of the wound, it must be palpated very carefully, and it is well to turn the patient on his back to do this, so that the kidney may be supported against the psoas and the quadratus lumborum.

The pelvis and substance of the kidney must first be palpated thoroughly, and if a stone be present in the pelvis it will usually be detected if it be of any size. In any case however the kidney should be incised, either to remove a stone previously felt or to investigate the interior of the organ when none is felt from outside; needling the organ is not only practically valueless, but is a waste of time, because the kidney must always be incised before the operation is completed.

While incising the kidney, the pedicle should be compressed so as to control the bleeding, and also to prevent any calculus falling into the ureter. The incision, which should be long enough to admit one or two fingers, is made about a finger's breadth behind the convex border of the kidney, where the anterior branches of the renal artery meet the posterior ones and the vessels are smallest. The incision is carried into the pelvis of the kidney, the interior of which is examined by the finger, introduced through the opening. If the finger fail to detect a stone, a small bladder sound is passed through the wound and a thorough examination of the various calices made *seriatim*. If still no stone be found, one finger is passed into the pelvis and the fingers of the other hand palpate the kidney from each side to see whether there be a stone imbedded in its substance. Finally the ureter is examined, first by palpation as far as it can be reached, and subsequently by a ureteral sound. This sound can generally be passed through the opening in the cortex, but, if necessary, a puncture may be made at the back of the

infundibulum, and the sound passed thence along the ureter. If a sound be used, it generally passes readily until the brim of the pelvis is reached, but some manipulation may be required to make it pass this point; with a gum-elastic instrument there is usually no difficulty, but a metal probe is desirable in order to tell whether a given obstruction be inflammatory or due to a calculus.

A stone in the pelvis of the kidney is generally fairly smooth and can be removed by lithotomy forceps. During removal the compression of the ureter must be kept up so as to prevent the possibility of a second stone slipping down into it. Smaller calculi may be removed by smaller forceps or a scoop, but very minute ones should be either flushed out or turned out with the finger.

Branched calculi may cause much trouble, as their removal entire would involve extensive laceration of the renal substance, while, if broken up and removed piecemeal, fragments may be overlooked; the latter procedure is however the best plan. The treatment of a calculus in the ureter is dealt with separately (see p. 233).

After the stone has been removed, the subsequent procedure depends upon whether the kidney is the seat of suppuration. *When there is no pyelitis*, the wound in the kidney is closed completely, which is advantageous in that it not only avoids a renal fistula but arrests the hæmorrhage immediately; the latter point however is not of great importance as bleeding can be kept under control during the operation by compressing the pedicle of the kidney, and the oozing from the cut surface is generally trifling by the time the operation is concluded. Before suturing the organ it is well to flush the renal pelvis with a stream of boiled water at a temperature of about 105° F., both to cleanse the parts and to arrest oozing. The sutures in the kidney should be partly deep and partly superficial much as for a laceration in the organ (see p. 191). When this has been done, the kidney is fixed to the loin by one or two sutures, especially when it has been possible to completely free the organ and bring it up into the loin before incising it. A drainage tube is inserted through the lumbar incision down to the region of the kidney, and the lumbar muscles are accurately united by buried sutures. *When pyelitis is present*, no attempt is made to close the renal incision. A large drainage tube is inserted well into the pelvis, and a second one will generally be required to drain the peri-renal area; it is also well to suture the kidney to the lumbar wall so as to avoid displacement of the tubes. If the tube be of sufficient size, it will compress the renal tissue as it passes through the opening in it, and serve to check oozing; if not, pressure by small strips of gauze alongside the tube will generally arrest it. All the structures in the loin are taken up by deep silkworm-gut sutures, and no buried sutures are used.

When the kidney has been sutured and the case remains aseptic, the drainage tube may be removed on the third day; should leakage of urine take place however, the tube should be retained until this has ceased, and care must be taken to keep the wound aseptic throughout. Should suppuration

occur in these cases, the treatment is similar to that for the cases in which there is pyelitis; the drainage must be continued until suppuration has ceased, and then the tube is gradually withdrawn. When a drainage tube is employed, care must be taken to see that it passes well through the lumbar muscles, as otherwise the patient may be subjected to attacks of deep-seated suppuration in the loin.

The after-progress of the case depends essentially upon whether pyelitis is present. After the operation there is free hæmaturia, and clots may pass along the ureter and give rise to renal colic. The bleeding gradually ceases after about 48 hours. There is often considerable shock and pain associated with the operation and the question of the administration of morphine for the relief of this is attended with some difficulty on account of the condition of the other kidney. At first the patient should be kept on a milk diet, but when the hæmaturia has ceased, he may have plain unstimulating food, with a large quantity of fluid. The bowels should be kept empty by daily enemata. Convalescence may last from about a fortnight up to several months. The patient should be kept in bed as long as there is any suppuration but, when the wound has contracted to a small size and only emits urine, he may be allowed to go about wearing a suitable apparatus to catch it.

Nephrectomy.—The cases for which this operation may be required, have been already indicated (see p. 227). The lumbar incision should always be employed so as to avoid soiling the peritoneum, and the “lumbo-ilio-inguinal incision” (see Fig. 49) is the best, as the ureter may have to be followed up for a considerable distance; if more room be required, it may be obtained by removing the last rib sub-periosteally (see p. 228). The abdominal route is only useful in nephrectomy for a tumour; in the great majority of cases of renal stone the organ can be removed perfectly easily through a lumbar incision, combined if necessary with the extension upwards already described (see p. 228).

There are usually numerous peri-nephric adhesions from which the kidney has to be shelled out; in doing this the organ may be ruptured, and pus will escape into the wound whence it must be removed by irrigation as fast as it escapes. The pedicle is gradually exposed, and the kidney is drawn out of the wound if possible; this must be done most cautiously lest the pedicle be shrunk and unable to bear traction (see p. 218). If it cannot be got out on to the loin it must be cleared *in situ*, and when this has been effected the ureter should be sought for, isolated and clamped. An aneurysm needle carrying a long stout silk ligature is next insinuated through the middle of the pedicle either from behind forwards or from before backwards as near the spine as possible, so as to leave sufficient length of pedicle on the renal side of the ligature, and divided into two. Each half of the ligature is tied separately and firmly, and finally one of them is carried round so as to enclose the whole pedicle, and its ends are left long so as to enable the pedicle to be examined for bleeding afterwards. A point of importance is to put the pedicle on the stretch while passing the aneurysm needle, but to push the kidney

back and completely relax the pedicle as the ligature is tightened ; unless this be done, the vessels may be incompletely compressed and may retract beyond the ligature. After the vessels have been tied, they are divided close to the kidney, and then the latter is brought out on the loin and the ureter examined and dealt with according to circumstances. The first essential here is to ascertain whether a stone be impacted in it, and this can be done by making a puncture into it below a clamp placed upon its upper end and passing down a ureteral sound ; it may generally be assumed that there is no obstruction if the ureter be not dilated below the kidney ; in that case it is ligatured about an inch below the pelvis and the kidney cut away. Finally the pedicle is examined to make sure that all the vessels are secured ; any oozing points may be caught up and tied separately.

Furious hæmorrhage is occasionally met with in the course of nephrectomy. Sometimes it is due to too severe traction upon the pedicle, which tears across the renal vein or even tears it away from the vena cava. Occasionally it may be due to division of these structures by the knife or scissors, while sometimes the ligature on the pedicle may slip or may not be tight enough, and the wound at once fills up with blood, so that it is impossible to see its source. As the hæmorrhage comes from the pedicle, the hand should be immediately thrust into the wound in all cases, and the pedicle of the kidney seized firmly, whilst the fingers may also compress the aorta and vena cava. This allows the blood to be sponged away, when the bleeding vessels can be seen and secured. The most dangerous hæmorrhage however comes from a lateral slit in the vena cava, most commonly produced by detaching the renal vein from it. If the orifice be small, it may be seized in forceps and a lateral ligature applied. Should that fail to hold, the best plan is to have the vein compressed above and below by an assistant's fingers or some flat instrument and to suture the slit with a fine continuous catgut stitch ; when this can be done it is most successful. Failing this, the only thing is temporary plugging of the wound ; luckily this succeeds in a good many instances, as wounds in the vein seal quickly after the kidney has been removed.

Opinions differ as to the best method of dealing with the divided end of the ureter. Unless there be reason to suspect sepsis in the wound, it is well to scrape away the epithelium from the cut surface and touch it with undiluted carbolic acid ; it is unnecessary to invaginate the open end above the ligature. When the ureter is itself suppurating and there is therefore every prospect of sepsis, this plan is unsatisfactory, as the ligature may give rise to a troublesome sinus, and it is therefore better to bring the end of the ureter into the lower angle of the wound and stitch it there with silkworm-gut, which can be removed in four days, when the ureter has contracted adhesions.

Occasionally it is impossible to tie off the pedicle as described above, and the best plan then is to apply a temporary ligature close to the kidney and remove the latter, leaving a portion of renal tissue attached to the pedicle. It may then be possible to apply a second ligature sufficiently far back to

allow this portion of the pelvis of the kidney to be removed; but if this cannot be done, the stump should be scraped and swabbed with undiluted carbolic acid and the ligature left long, with its ends hanging out of the wound, in case suppuration and separation of the ligature should occur. Should no suppuration occur, the ligature may be cut short by scissors as deep down in the wound as possible and the tissues allowed to close over it. This plan will obviate those troublesome sinuses, sometimes lasting for years, which so frequently follow the removal of a suppurating kidney when the ends of the ligature on the pelvis are cut short and the stump allowed to drop back deep into the loin.

It will occasionally happen that the adhesions are so dense and the pedicle of the kidney is so short that it is impossible to free the organ sufficiently to remove it in the ordinary fashion, and a modified operation, sometimes called a *sub-capsular nephrectomy*, has to be performed. In order to do this, the proper capsule of the kidney is freely divided and the organ is enucleated from within it; while this is being done, the renal pedicle is compressed by an assistant, so as to check the bleeding. As much of the kidney as possible is shelled out piecemeal from the capsule, and finally the pedicle is tied up *en masse* and the kidney capsule is cut away, after which it may be possible to isolate and tie the individual vessels. This form of operation should only be done when nothing else is possible, and is inadmissible if the kidney be tuberculous.

After the kidney has been removed and the ureter secured, a large drainage tube is introduced through the posterior angle of the wound, the rest of which is brought together by interrupted silkworm-gut sutures, taking up the whole thickness of the lumbar wall; buried sutures must not be used, as suppuration is likely to occur. The patient is put back to bed with the arm on the affected side bound to the trunk, and with the knees flexed over a pillow and fastened together. There is generally a good deal of shock, with considerable pain and abdominal tenderness, and to meet this there is no objection to giving injections of morphine if the other kidney be fairly healthy. The intense thirst so often complained of is best relieved by allowing the patient to suck ice or to take soda-water in small quantities by the mouth, and by hot saline rectal enemata, about a pint and a half at a time. There will probably be free oozing, and the wound will require dressing frequently in the first 48 hours.

Treatment of renal colic.—The first indication is to alleviate the pain and spasm, and thus to facilitate the passage of the stone along the ureter. Morphine injections should be given and repeated every three or four hours if necessary; it is well to combine them with atropine but, before using them, the urine must be examined and, if there be only enough albumen present to be accounted for by the pyuria, morphine may be given without hesitation. A bath as hot as can be borne should be administered, and the patient should be left in it until he feels faint; while in it he must be watched, and when he feels faint he should be

immediately put back to bed. The shoulders and thighs should be raised so as to relax the abdominal muscles. If the pain be too severe for these methods to allay it, inhalation of chloroform may be resorted to, but cases where this is necessary are very rare. As a rule the stone passes in a few hours, or goes back into the renal pelvis. Should it become impacted it must be removed as described below (see p 234).

URETERAL CALCULUS.

The surgeon may be called upon to deal with a calculus impacted in the ureter under two different sets of circumstances. On the one hand he may find that in the course of an operation for renal stone the ureter is blocked by a second calculus, which of course will require removal either at the time of the operation, if the patient's condition allows it, or at a subsequent period when the effects of the kidney operation have been somewhat recovered from. On the other hand the case may be primarily one of ureteral calculus, and there is therefore no necessity for cutting down upon the kidney itself, the stone in the ureter being the sole lesion.

The diagnosis of a calculus impacted in the ureter, as distinguished from a similar condition in the kidney, is of course of great practical importance, as it is obviously of advantage not to practise more operative interference than is absolutely necessary.

An important point in the diagnosis is that the escape of urine from the affected side is interfered with by the calculus impacted in the ureter, and it is easy to determine this fact by the aid of the cystoscope after injection of methylene blue (see p. 169). The coloured urine will be seen issuing from the sound ureter, while none comes from the affected one. This however does not tell the surgeon more than that the ureter on that side is occluded, and of course this may be due to a stone impacted in any part of its course. If the other kidney be healthy and there be no reflex anuria, dilatation of the ureter and pelvis of the kidney will occur above the obstruction, and there will be a tumour in the loin. Should the stone act as a sort of ball-valve at the commencement of the ureter, a condition of intermittent hydronephrosis will be established. When hydronephrosis is present, the blockage is incomplete; when the obstruction is sudden and complete, the kidney may undergo atrophy without hydronephrosis occurring. The condition set up by the blockage of one or both ureters by a stone is termed "calculous anuria."

Occasionally, especially in spare subjects, the calculus may actually be felt through the abdominal wall, through the rectum, the vagina or the bladder, and it may be possible in suitable cases to get accurate information by means of the X-rays. The most common seats of impaction are the points at which the diameter of the ureter is smallest, viz., about two inches from the hilum of the kidney and at the vesical

end of the ureter; there is another slight narrowing where the ureter crosses the brim of the pelvis. The clinical symptoms however are rarely sufficiently definite to enable the diagnosis to be made with confidence unless the stone can be felt.

When the stone is impacted in the lower end of the ureter it may escape into the bladder by ulceration. The ureter above the obstruction becomes thinned, and may be inflamed or ulcerated, and undergo sloughing and suppuration. Usually however it becomes much thickened and dilated. When a stone is impacted in this situation in the female, it is fairly easy to feel it per vaginam. In the male, digital examination of the rectum will not often lead to its detection but, when impacted in or near the ureteral orifice, the protrusion of the mucous membrane of the ureter may be recognised by the cystoscope.

TREATMENT.—The calculus must be removed without delay, if possible, by an extra-peritoneal operation. The exact steps of this will depend both upon the seat of impaction and also upon whether the stone in the ureter be the sole lesion. In very doubtful cases a median exploratory laparotomy may have to be performed in order to ascertain the condition of both ureters throughout their whole length; if this be done, the laparotomy wound should, if possible, be closed and an extra-peritoneal operation performed for removal of the stone from the ureter.

When a stone is found in the ureter at the time of an operation for renal calculus, it is best to remove the ureteral stone forthwith if the patient's condition warrant it and if the calculus be easily accessible from the lumbar wound. The patient is generally fit to stand the necessary prolongation of the nephro-lithotomy if the calculus be impacted above the brim of the pelvis; when however it is situated lower down, this is not always the case. In the male it is advisable to proceed immediately to remove the stone, unless it be impacted close to the vesical orifice of the ureter, in which case it is probably better to wait a few days, unless there be already symptoms of complete calculous anuria. In the female however, when the stone is situated behind or below the broad ligament, it is always well to defer removal to a second operation, except under similar circumstances.

When the calculus is situated in the upper part of the ureter, an attempt to press it gently back into the renal pelvis will frequently succeed, and it can then be removed without difficulty. When it is situated lower down, but still above the brim of the pelvis, the ureter is easily exposed by a slight prolongation downwards of the nephrotomy incision, which enables the peritoneum to be pushed forwards as far as the brim of the pelvis. There is no difficulty in tracing down the ureter, as, although it tends to be carried forward with the peritoneum, it can be traced from the renal pelvis, and the stone in it is at once manifest. In this situation it is usually impossible to press the calculus up into the pelvis of the kidney without unduly damaging the ureteral wall, and it must therefore be removed by *ureterotomy*. An

incision about the length of the stone is made parallel to the long axis of the ureter, commencing well above it and reaching only just down to the upper border of the calculus; the incision should not be made over the stone itself, unless it be absolutely necessary, as the ureteral wall there is much thinned and distended, and the stitches employed to close the opening subsequently may cut through. After incising the ureter, the stone is manipulated upwards and extracted, and the incision is closed by two or three Lembert's sutures, care being taken not to invert the edges too much, as otherwise stenosis might occur. Some surgeons prefer not to use sutures for fear of this accident, and, as a matter of practice, it is found that, when the peritoneum and the abdominal contents fall back into place, the incision in the ureter is pressed against the loin and little extravasation occurs; we prefer however to put in a few fine sutures. A drainage tube should be introduced down to but not into actual contact with the incision, so that if any urine escapes it may be drained off.

A probe should always be passed through the incision in the ureter and a second calculus felt for before the operation is completed. If one be found, it may either be removed at the same operation, if possible by squeezing it up to the first incision or failing that by a separate one, or else its removal may be undertaken at a later date.

When the stone lies in the true pelvis the stone can still be reached by the "lumbo-ilio-inguinal incision," which is made by prolonging the nephrotomy incision downwards (see p. 219) and allows exposure of the ureter almost to its insertion in the bladder. In the female the broad ligament interferes with this procedure, and a vaginal incision must be employed; a vertical incision is made in the anterior cul-de-sac of the vagina, the cervix uteri being dragged forcibly downwards and backwards with a tenaculum so as to make this tense. The bladder is then separated with the finger as far up as the vesico-uterine cul-de-sac, when the ureter containing the stone is easily exposed. A longitudinal incision is made for the removal of the stone, and after extraction it is usually unnecessary to suture the ureter. A few stitches in the vagina, leaving between them sufficient space for any leakage of urine, will be enough.

When the calculus is impacted in the lower end of the ureter, but too high up to be got at through the bladder or vagina, the sacral route (see p. 220) should be adopted in the female; in the male this part can usually be got at by the "lumbo-ilio-inguinal incision" and is an unusual situation for the stone to be impacted in. The sacral route may be adopted in the male however if it be certain that the calculus is impacted in this situation, and there is therefore no reason to operate from the loin.

When the stone is impacted close to the bladder or in the vesical wall itself, it must be got at from below and, when it is outside the wall of the bladder but close to it, the sacral route should be employed in the male. When the calculus is actually impacted in the vesical part of the ureter it may be removed from the bladder itself. In the male a supra-pubic

cystotomy will be required, and is preferable to a perineal cystotomy, as a good view is obtained, and the stone may be made to project by pressure from the rectum. In the female the urethra is dilated, a Kelly's urethral tube is inserted, and the stone is projected forward from the vagina, so that the orifice of the ureter is rendered readily accessible. Bougies, or fine forceps, may then be introduced into the ureteral orifice, which is gradually and gently dilated, and then, with one finger in the bladder and one in the vagina, an attempt is made to squeeze the stone out into the bladder, or at any rate to protrude it sufficiently to allow it to be seized with forceps and extracted. Should this fail, the orifice of the ureter may be slit up with a probe-pointed bistoury, and a small scoop or curette used to get out the stone. Throughout any attempt of this kind an assistant should keep his forefinger in the rectum or the vagina to prevent the calculus slipping upwards from the ureteral opening. The enlargement of the ureteral orifice must be done carefully, as it is important not to cut completely through the muscular wall of the bladder, and allow urine to percolate into the cellular tissue. However, the obliquity and dilatibility of the canal in the bladder wall will usually allow the stone to be extracted through a comparatively small incision. In the male the procedure after supra-pubic cystotomy is similar, although it is not so easy.

SUPPRESSION OF URINE.

Among the complications associated with stone, especially after an operation, is suppression of urine, which may be either obstructive or non-obstructive. By obstructive suppression is meant blocking of the ureter or ureters—it is called “calculous anuria”; by the non-obstructive form, a condition in which suppression is brought about reflexly by the shock of an operation acting upon kidneys already diseased.

CALCULOUS ANURIA.—This is the most serious complication of renal calculus and may occur independently of operation from blockage of the ureter by a calculus. Occasionally calculi block both ureters, but when calculous anuria occurs it usually implies that the patient has only one functionally active kidney, and that a calculus has blocked its ureter. As a sequela of operation it usually follows nephrectomy, a stone falling into the opposite ureter and blocking it; it is hardly likely to occur after nephro-lithotomy, unless the organ operated upon be badly diseased, because that kidney will go on secreting, provided there be free escape for urine either through the ureter or through the lumbar wound. When however little kidney substance is left, the blockage of the opposite ureter may lead reflexly to arrest of secretion in the kidney operated upon. At first the condition is simply one of obstruction, but very soon the secretion of urine ceases.

Symptoms.—The symptoms differ in their mode of onset and in their character from those due to other forms of obstructive anuria, such

as pressure on the ureter by a cancerous uterus. In most cases there is at first pain in the kidney on the affected side, but this usually subsides in a day or two; occasionally there is no pain, and no history of a previous attack of renal colic, and thus it may be difficult to determine on which side the blockage has occurred. There is usually a constant desire to pass water, and the anuria may be partial or complete; in the former case the small quantity of urine passed is of low specific gravity, and does not suffice to delay the fatal termination. When anuria occurs after an operation, the general condition is comparatively good, the mind is unaffected, and the pulse and temperature are fairly normal. The patient may even be able to take food, there may be no vomiting or nausea, and the tongue may be clean, and is often moist. There is generally sleeplessness, but no definite restlessness, and little or no delirium and, whether the condition follows an operation or not, it may be eight or ten days¹ before symptoms of uræmia set in; indeed, death may occur without any characteristic symptoms of uræmic poisoning, but when they appear death follows very rapidly.

The condition is markedly different from the non-obstructive form of anuria—the ordinary suppression of urine—and is readily diagnosed from it. There the headache, nausea, vomiting, slow pulse, dry tongue, early onset of uræmic convulsions and the drowsy and semi-delirious condition of the patient sufficiently indicate what has happened.

The diagnosis of calculous anuria from other obstructive conditions may be made by the sudden onset, the pain in the kidney, a previous history of renal calculus, and by the absence of any other obstructing cause, such as a tumour in the pelvis.

Treatment. (a) **Of obstructive anuria.**—The treatment of calculous anuria is either to do a nephrotomy and allow the urine to escape through the pelvis of the kidney, or to remove the stone from the pelvis of the kidney or the ureter. Hence, the first point is to determine the side affected, and the second to ascertain the seat of the calculus. When nephrectomy has already been performed on one side, it only remains to ascertain where the impaction on the other side has taken place. Palpation along the line of the ureter, examination per rectum or per vaginam, examination of the ureteral orifice by the cystoscope in the male, or after dilatation of the ureter in the female, and the X-rays should be resorted to, and when the position of the stone has been ascertained it is removed on the lines already laid down (see p. 234).

Frequently the patient is not in a condition to stand a prolonged operation, and then the best plan is to do a lumbar nephrotomy and establish a temporary renal fistula. The sooner this operation is performed the better, as otherwise the kidney may not secrete again, and the patient may die in spite of the operation. When the anuria does not follow

¹ Morris states that as long as 25 days has elapsed after the onset of anuria before death took place.

nephrectomy, the nephrotomy should be done on the side last affected, that is to say, that on which there were symptoms of renal calculus last, for the kidney that has been longest affected may be entirely destroyed. When the patient has recovered from the anuria, the calculus should be removed. When the calculus is situated in the vesical end of the ureter, the stone may perhaps be removed at once, instead of performing nephrotomy; but, when the patient is in a serious condition, an operation such as that by the sacral route (see p. 220) would probably increase the shock so much that the kidney would not secrete again in spite of removal of the stone.

(b) **Of non-obstructive anuria.**—The treatment of this condition is essentially medical, and among the best measures is the hot-air bath. The bedclothes are arranged over a long cradle, and tucked in everywhere, and hot air or steam is conducted beneath them by means of a tube; the patient is left in this atmosphere for half-an-hour or an hour, when profuse sweating generally occurs. If hot air be used, the tube terminates in a funnel inverted over a lamp, while if steam be employed, an ordinary bronchitis kettle may be used. Hot air is preferable. The greatest care must be taken that no portion of the funnel or tube touches the patient. A substitute apparatus may be improvised by surrounding the patient with blankets outside which hot-water bottles are packed; in all cases signs of cardiac failure or increasing anæmia must be carefully watched for.

Still more certain is the hot wet-pack in which a thick blanket is saturated with water almost boiling and then rapidly wrung out to remove all excess of moisture. The patient is quickly and entirely swathed in this, with the exception of the head and face, and outside are placed several blankets; the patient is left in the pack for a couple of hours, at the end of which time he generally sweats profusely. He is then rubbed dry and well covered up with hot dry blankets. During the time he is in the pack he should drink freely of hot barley water or other diluent drinks. The action of the wet-pack or of the hot-air bath may be greatly increased by the administration of a subcutaneous injection of pilocarpine (gr. $\frac{1}{12}$ to $\frac{1}{2}$), but its effect must be carefully watched as it may produce dangerous depression. Brandy and water should be given if these symptoms occur. Dry cupping to the loin is valuable.

RENAL FISTULA.

This is a convenient term to apply to sinuses in the loin, which need not however all have a renal origin. They may be divided into two large groups: (1) Non-urinary, and (2) Urinary fistulæ.

NON-URINARY FISTULÆ.—These arise from very various causes and may have no connection with the kidney at all. They may follow peri-nephric abscess due to disease of the appendix, gall-bladder, duodenum or colon or contusions of the loin which fail to heal either because there is imperfect drainage or because the original cause is still active. When the

primary cause persists, no treatment will be of any avail that does not remove this. An important cause of these non-urinary sinuses is an operation on the kidney followed by suppuration and extrusion of stitches, or a sinus in connection with the upper end of the ureter after nephrectomy. They may also be caused by disease of the kidney itself, such as a peri-nephric abscess due to stone or tubercle and, although no communication may exist with the pelvis of the kidney, the wound may not heal on account of the original disease of the kidney which led to their formation.

Treatment.—*When the persistence of the fistula is due to imperfect drainage this must be rectified.* When a peri-nephric abscess is not opened until it has lasted a long time, it may have burrowed extensively, and healing may be delayed by imperfect drainage of the outlying recesses, or the part of the sinus passing through the lumbar wall may tend to contract before the deeper parts have healed. The treatment is dilatation of the external orifice and maintenance of a free exit for discharge from the interior. The sinuses may be either gradually dilated or they may be slit up; to forcibly tear open the sinus with forceps may lead to accidents, as the peritoneum or even the colon may be torn. The best way is either to gradually dilate them with bougies or laminaria tents or to enlarge them with a knife in the backward direction. *When the sinus is due to suppurating stitches or to a septic ureter,* the proper treatment is to remove the offending stitches in the first case or in the second to expose the ureter if possible and dissect it out; short of that, scraping out the sinus and removing stitches is all that can be done. *When the sinus is due to renal disease,* the question of an operation on the kidney itself will naturally arise; when stone is suspected, a nephrolithotomy or a nephrectomy; when the kidney is tuberculous a nephrectomy will probably be required.

URINARY FISTULÆ.—These are the more important cases and may arise after operations, such as nephro-lithotomy, simple nephrotomy or operations for tuberculous kidney. We may classify the fistulæ into two groups, namely, those in which the fistulous opening has been deliberately established for drainage of the pelvis of the kidney, as for example in pyelitis; and those in which the urinary fistula has accidentally followed an operation upon the renal pelvis.

Before determining on treatment, it is of the highest importance to ascertain the condition of the opposite kidney, and also whether the urinary fistula is complete, that is to say whether all the urine from the affected kidney passes through the loin. The latter point is a very simple matter to determine by the methylene blue test (see p. 169); when the fistula is complete, the condition of the urine in the bladder will indicate sufficiently the condition of the opposite kidney. If it be incomplete, the ordinary measures already described must be had recourse to (see p. 171). Occasionally it may be possible to temporarily render an incomplete renal fistula complete by suitable methods of blocking the affected ureter by plugs, gauze, etc., but this is not easily done as the sinus may be very small. Another very important point is

to ascertain whether the ureter on the affected side be patent or, if it be blocked, whether it be feasible to remove the obstruction so as to restore the patency of the tube, and allow the fistula to heal. In some cases, such as those already referred to in the treatment of calculous anuria (see p. 237), the fistula has been deliberately established because the condition of the patient was so bad that a prolonged operation was not feasible, and here therefore the condition of the ureter is well known. In others the urinary fistula has only been established temporarily with a view to the performance of nephrectomy when the patient is able to stand the operation, and in other cases again the intention in establishing the fistula is that it shall be permanent; this latter measure is only adopted when the surgeon thinks that the opposite kidney is too extensively diseased to successfully assume the functions of the affected one. Even here however, it may be found after the lapse of some time that the condition of the opposite kidney is much better than was expected, and that there is therefore no longer the same objection to nephrectomy. There is no doubt that the annoyance of a urinary lumbar fistula is so great that the patient will always beg to have something done to cure it if this be possible.

Treatment.—It is unnecessary to go into the treatment in detail as this follows from what has been said as to the treatment of the various affections in the course of which the fistula arises. Thus, when it is due to blockage of the ureter, the obstruction must be removed if possible and if not a nephrectomy should be done if the opposite kidney be sound. When it is due to an accidental wound of the pelvis of the kidney, and the organ itself is healthy and the ureter is patent, it is probable that, if the sinus refuses to close after the establishment of efficient drainage, freshening the edges of the wound followed by suture of the wound in the pelvis of the kidney will succeed. When the fistula is due to disorganisation of the organ from suppuration or from tuberculous disease, nephrectomy is clearly indicated, if the condition of the opposite kidney permits.

CHAPTER XXIII.

HYDRONEPHROSIS.

Two varieties of this condition may be met with, viz., hydronephrosis proper and the intermittent form. Pyonephrosis has already been discussed (see p. 210).

HYDRONEPHROSIS PROPER.

Distension of the pelvis of the kidney may be due to various causes producing obstruction of the ureter. This obstruction must be temporary at first, as complete blockage of the ureter leads to atrophy of the kidney rather than to hydronephrosis.

CAUSES.—There may be imperfections in the ureter or a narrowing of its lumen from some congenital cause, but the affection met with in practice is more commonly acquired. Any interference with the escape of the urine from the pelvis of the kidney may give rise to hydronephrosis provided that the obstruction be not complete from the first. Stricture of the urethra, enlarged prostate, a vesical tumour pressing upon the ureteral orifice, simple or tuberculous inflammation of the ureter leading to strictures, calculi in the ureter, tumours, bends, twists, or valvular obstructions may all give rise to this condition. Pressure outside the ureter by tumours is also an important factor, and one of the commonest causes of hydronephrosis found on the *post mortem* table is a malignant pelvic tumour such as uterine cancer.

The condition may be unilateral or bilateral. In the majority of cases it is one-sided, but in a certain number, and especially when it is caused by a tumour in the pelvis, it is bilateral, although it is then generally more advanced on one side than on the other. A small hydronephrosis is a comparatively common affection, but the cases marked by large hydronephrotic tumours are much rarer, for, unless there be some outlet for the urine, atrophy of the kidney substance is apt to take place before any large swelling has formed. The affection is more common in women than in men.

PATHOLOGICAL CHANGES.—The pelvis and calices of the kidney become greatly dilated, and the cortex is compressed and atrophied. The

kidney is frequently comparatively small, but occasionally it forms a large tumour which may even entirely fill the abdomen, and then adhesions may occur between the capsule and the peritoneum or the intestine. The fluid in long-standing cases consists of water, with a little chloride of sodium and an almost entire absence of albumen, uric acid, or urates.

SYMPTOMS.—These may extend over a number of years and vary much in intensity; they may be entirely absent. When present they consist mainly of pain in the back, frequent micturition, and considerable dilatation of the pelvis of the kidney. If the affection be bilateral, nausea, sickness, a dry, sallow skin, and a certain amount of uræmia may be present. The tumour formed by the hydronephrosis is of varying size, irregular and lobulated, situated in the flank, easily pressed backwards into the loin, and displacing the colon forwards. Hæmaturia is very rare, but is said to occur. The situation and shape of the tumour, the history, the presence of the colon in front and to its inner side, accompanied by dulness in the flank and loin, together with the fact that the patient at times passes too little urine, whilst at others there is an unduly large quantity, these periods corresponding with the variation in size of the tumour should enable a diagnosis to be made.¹ Puncture of the swelling from the loin and examination of its contents will still further clear up the matter.

The prognosis depends on the cause of the distension and on whether one or both kidneys are involved. In the latter case the patient may gradually die of uræmic poisoning, from pressure on the neighbouring organs or from rupture into the peritoneum. In a few cases the tumour has disappeared spontaneously.

TREATMENT.—The first point is to ascertain, if possible, whether there be any cause in the lower urinary tract to account for the affection, and, if so, to remove it. Strictures of the urethra, enlarged prostate, or any bladder mischief, should be examined for and suitably treated. Similarly pelvic tumours must be dealt with and removed, if possible; if not, the question of dividing the ureter above the tumour and implanting it into the bladder higher up, into the bowel, or even on to the skin of the loin, must be considered. These methods have already been described (see p. 198); if a stone be felt impacted in the ureter, it must be removed (see p. 234). In a certain number of cases however there is nothing wrong in the lower urinary tract, and the cause is in or close to the kidney; and when there are no marked symptoms, and the tumour is not increasing rapidly, and the other kidney is sound, it is an open question whether the affection should not be left alone for the time being, if no removable cause can be found. Attempts to get rid of the fluid by massage or manipulation, or by catheterising the ureters, are not advisable; they cause much trouble and are not likely to do good.

Three chief methods of treatment are at the disposal of the surgeon when

¹ Although this variation is most valuable as a help to diagnosis, it is by no means always met with.

active measures are required on account of increasing size of the tumour, pain, or other symptoms :

Simple tapping.—This operation was much practised at one time, and it has sufficed to cure the trouble ; this however can only happen when the kidney structure is entirely destroyed and a cyst is left containing fluid, into which after tapping, possibly more than once, no fresh fluid is secreted, so that the cyst wall shrinks and the tumour disappears. It is important to secure complete asepsis, as otherwise suppuration will result.

The best point for puncture is midway between the last rib and the crest of the ilium, about two and a half inches behind the level of the anterior superior spine. A needle passed horizontally in at this point would puncture the colon in a healthy subject, but hydronephrotic tumours which are large enough to require tapping will displace the colon sufficiently forwards for it to escape damage. A moderately fine aspirating needle is employed and no evacuating bottle need be used, as the fluid is thin and the pressure within the cyst is sufficient to make it flow readily. As a rule this method is insufficient, and the surgeon has then to choose between the two following methods which involve free exposure of the hydronephrotic tumour and the parts in its neighbourhood :

Nephrotomy.—This is best done by an incision corresponding to the upper half of the “lumbo-ilio-inguinal incision” (see p. 219), and the tumour is exposed in the ordinary way, isolated in the usual manner, and the ureter cleared and examined. If the tumour be large it may be necessary, after as much of the sac has been cleared as possible, to tap it before the ureter can be sufficiently got at. Examination of this structure is then easy as the cyst collapses. It is most important to ascertain the condition of the ureter as some removable obstruction may be found, the treatment of which may obviate the necessity for removing the kidney. The examination of the ureter can be effected partly by palpation and partly if necessary by making a small incision in the back of the infundibulum, and introducing a ureteral probe in order to determine its patency. If a stone be met with it should be removed (see Chap. XXII.), while a stricture should be treated on the lines laid down for plastic operations upon the ureter (see p. 246). In the majority of cases of bad hydronephrosis however the obstruction is irremediable by the time an operation is performed, and the surgeon has only to make up his mind whether he will establish a lumbar fistula or whether he will go on to remove the kidney. The third course of establishing a temporary lumbar fistula with a view to secondary nephrectomy will sometimes present itself to him.

Nephrectomy.—*When the kidney is completely destroyed*, it is clear that this is the only suitable procedure ; removal of the sac cannot interfere with the patient's urinary functions, and the only cases in which a surgeon will hesitate to perform nephrectomy is when the patient is so feeble, as for example from the result of the pressure of an enormous tumour upon the duodenum, that it is advisable to relieve this first, and to proceed to nephrectomy subsequently. Under these circumstances the sac should be

laid freely open, its edges stitched to the lumbar incision, and a drainage tube inserted. In a few weeks' time, when the patient has recovered somewhat, a secondary nephrectomy may be done; whenever it is possible however primary nephrectomy should be chosen, as it is a much easier operation.

When however a certain amount of secreting tissue still remains, the important question is the condition of the opposite kidney. When this is clearly good, and only very little secreting substance is left on the diseased side, primary nephrectomy is the proper procedure. If there be any doubt, a temporary urinary fistula may be established and, when subsequent examinations have satisfied the surgeon that the opposite kidney is healthy, a secondary nephrectomy can be performed if the patient insists upon it, as he will if the fistula causes much inconvenience or if accidental circumstances, such as suppuration along the fistula, should occur and render its presence dangerous. We may sum up the radical treatment of hydronephrosis as follows:

1. Removal of any ascertainable cause of obstruction; this will probably result in a perfect cure.
2. When an irremovable obstruction is found low down in the ureter, the tube may be transplanted into the most suitable position available.
3. When no obstruction is found low down in the urinary tract, the tumour should be exposed and any removable obstruction properly dealt with. This again should result in a perfect cure.
4. When the obstruction is irremovable, a permanent urinary fistula should be established when there is a considerable amount of secreting structure left in the affected kidney, and the condition of the one on the opposite side is not satisfactory.
5. A nephrotomy followed by the establishment of a temporary renal fistula should be done when the patient is in a weakly state of health, which may be expected to improve after the cyst has shrunk up; this should also be done when the condition of the other kidney is not known, and also when some obstruction is found which it is possible to remove although it may be inadvisable to do so at the time the nephrotomy is performed.
6. Nephrectomy should be done as a primary operation when the kidney is completely destroyed, and a mere cyst is left. It should also be done for the cure of a renal fistula when the patient desires it, and the state of the other kidney is known to be good.

INTERMITTENT HYDRONEPHROSIS.

This is an important condition, the significance of which has been only recognised comparatively recently. In it there is intermittent dilatation of the pelvis and calices of the kidney by an obstruction, which is to some extent relieved from time to time. The patient may have

intervals during which he is quite well and the kidney appears normal, and then, apparently without any cause, there is violent pain in the loin, sometimes accompanied by vomiting and gradually increasing distress, and a distinct swelling can be made out in the renal region. This swelling is often tender, and may go on increasing for two or three days, when it may gradually or even suddenly disappear. Accompanying the formation of the swelling there is a diminution in the amount of urine secreted, and there may be increased frequency of micturition and sometimes hæmaturia. When the distension passes off, especially if it does so suddenly, there is an increased flow of urine of low specific gravity; the intervals between the attacks vary. Patients suffering from this condition are usually subject to movable kidney, sometimes to a very marked degree.

CAUSES.—A stone in the renal pelvis may temporarily block the entrance to the ureter, and give rise to intermittent hydronephrosis, but the most frequent cause is some abnormal condition of the ureter itself. There may be a stricture or a temporary kinking of the ureter in connection with movable kidney. A not uncommon condition is for the ureter to come off from the pelvis higher up

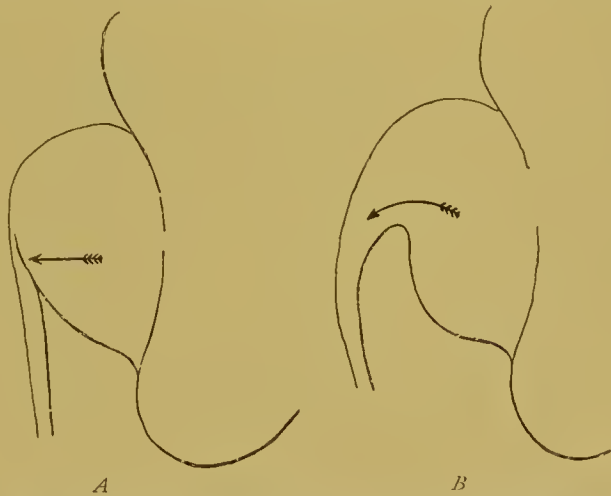


FIG. 50.—DIAGRAM SHOWING HOW FAULTY ATTACHMENT OF THE URETER MAY CAUSE INTERMITTENT HYDRONEPHROSIS. *A* shows how the lower part of the pelvis may become dilated as a result of the unduly high attachment of the ureter. This produces a valve-like pressure of one side of the ureter against the other, and still further distension of the pelvis. When this has reached a certain point, the valve is opened by the great dilatation and the urine in part escapes (*B*).

than it should, so that a sort of valve is formed and distension of the pelvis with urine is accompanied by pressure of one side of the ureter against the other, preventing the exit of the urine (see Fig. 50). This condition may be congenital, but it can also be acquired as a result of repeated kinking of the ureter due to movable kidney; in consequence the pelvis becomes dilated, especially below, so that a sac is formed at a considerably lower level than the point of exit of the ureter, and the latter is apparently displaced abnormally high up on the side of the pelvis. It is not quite clear why this condition should give rise to intermittent hydronephrosis, but it is possible that when the upper part of the pelvis is considerably distended, this opens up the valvular flap, and so permits a certain amount of the urine to escape.

This condition is of course very deleterious to the kidney, and may ultimately lead to complete blockage with true hydronephrosis. The patient usually suffers so much from these recurrent attacks that he is

ready to have anything done that will afford relief, and the following are the chief points in treatment:

TREATMENT.—During an attack the patient should be kept absolutely at rest in bed, morphine should be administered, and hot fomentations applied. When the attack has passed off, as it usually does in a few days, the question will arise as to whether anything curative should be done. There is no question that this will be necessary after repeated attacks, and the patient will usually readily consent.

The kidney should be exposed by an incision corresponding to the upper half of the lumbo-ilio-inguinal incision (see p. 219) and the upper part of the ureter and the pelvis of the kidney are examined, the organ

being brought out on to the loin in the usual manner, so that it can be examined both by sight and by touch. If a stone be found it should be removed (see p. 227). Nothing abnormal may be found beyond undue mobility of the kidney, and in that case it is well to make a small opening in the posterior part of the pelvis, and to introduce a ureteral probe when, if the ureter be found patent, and arising from the pelvis in its normal situation, the surgeon may assume that it is a commencing case due to movable kidney, which should be then fixed in the loin in the usual manner (see p. 177).

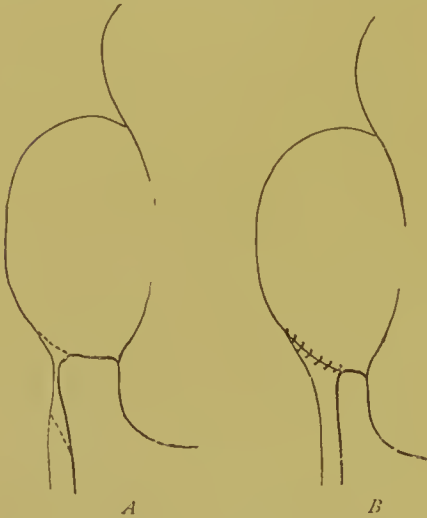


FIG. 51.—TREATMENT OF A STRICTURE OF THE URETER, JUST BELOW THE RENAL PELVIS. The stricture is completely excised by an oblique incision, as shown in *A*, and re-attached to the pelvis of the kidney so that there is a suitable opening, as seen in *B*. This is better than attempting a plastic operation for increasing the ureteral lumen.

When an abnormality is present in the upper part of the ureter or its attachment to the pelvis, something further must be done. If a small annular stricture be found immediately below the pelvis, this must be treated by an operation similar to pyloroplasty (see Part VI., Sec. I., p. 238); this operation however is not always successful. If the stricture be very tight, the affected portion of the ureter may be resected, and ureteral anastomosis (see p. 195) performed. Either of these operations is preferable to nephrectomy or to the establishment of a urinary fistula. When the stricture is situated quite close to the renal pelvis it may be excised, and the lower end of the ureter provided with a new attachment at the lowest point of the pelvis, the upper end being invaginated and closed by Lembert's sutures (see Fig. 51). It is well to cut the ureter obliquely or, if transversely, to slit it down for a centimeter or two, and round off its angles so as to make an opening of suitable size. The union is made by a double row of stitches, the mucous membrane of the pelvis and of the ureter being united by fine catgut, and a row of Lembert's sutures

being applied outside. A drainage tube should be introduced close to the new union for some days to provide against leakage.

When there is a valvular obstruction at the junction of the ureter with the pelvis, a very useful method is to open the pelvis of the kidney and, after introducing a probe through the ureteral orifice, to divide the adjacent ureteral and pelvic wall in front of it for nearly an inch, taking care however not to go too low down, as otherwise the cellular tissue around the organ will

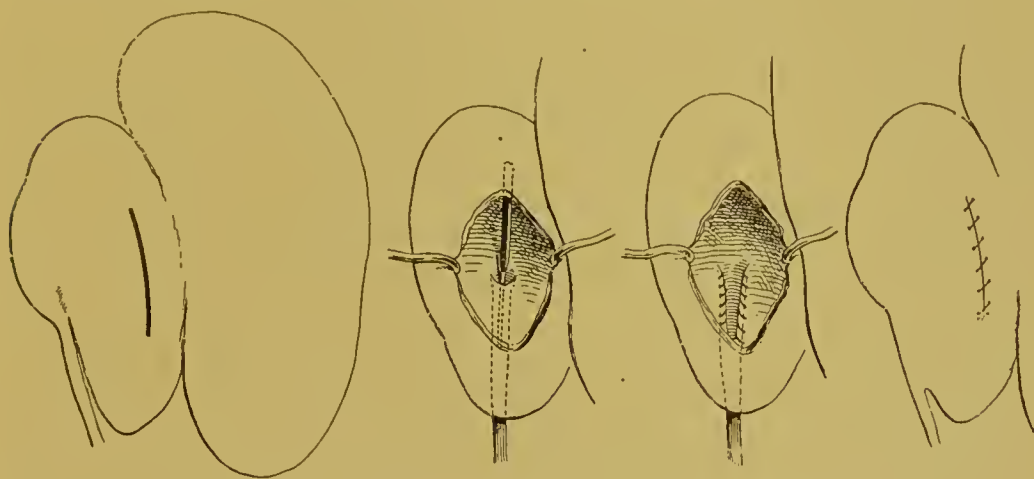


FIG. 52.—METHOD OF TREATING A VALVULAR CONNECTION BETWEEN THE URETER AND THE RENAL PELVIS. This is the operation described in the text and is done through a separate incision in the renal pelvis which is afterwards closed by suture. By its means a valvular opening is converted into an efficient one situated at a lower level on the wall of the renal pelvis, and the valve-action is done away with.

be opened up and there may be leakage (see Fig. 52). When the valve has been divided in this way, the mucous membrane of the pelvis and the ureter are closely united by interrupted catgut sutures, and it is well to put one or two Lembert sutures outside at the lower angle of the incision so as to make quite sure that no leakage occurs. The opening in the pelvis of the kidney is closed by Lembert's sutures, and it is always well to fix the kidney to the loin in the usual manner (see p. 177) so as to prevent kinking.

If these methods fail and the attacks of hydronephrosis persist in spite of them, nephrectomy will have to be considered. As a rule the condition is unilateral and if so, and if the patient insist on it, there is no objection to nephrectomy. The only alternatives are either to drain the hydronephrosis through the loin or to attempt to dilate the ureter with bougies; the latter method is very difficult and uncertain.

CHAPTER XXIV.

NEW GROWTHS OF THE KIDNEY AND ITS PELVIS: PERI- AND PARA-NEPHRIC TUMOURS.

TUMOURS OF THE KIDNEY.

MORE than two-thirds of the new growths of the kidney are malignant, sarcoma being more frequent than carcinoma. Carcinoma usually occurs in older people, is accompanied by more profuse hæmaturia, the pain is usually greater and the cachexia occurs earlier. Of the benign tumours the most common are cystic degeneration and hydatid cysts. Simple tumours, such as myxomata or dermoids are very rare and are hardly ever diagnosed until the kidney has been exposed.

SYMPTOMS.—These are often very obscure, the chief being hæmorrhage, pain and the appearance of a tumour. Hæmaturia may be one of the earliest symptoms of malignant disease of the kidney and is often the first that attracts the patient's attention. It occurs spontaneously, it is not affected by exertion, it is commonly profuse and it may last for some days, subsiding and re-appearing after a short time, its appearance often being ushered in by pain. The blood is intimately mixed with the urine but is apt to clot, and the clots may give rise to renal colic. There is no hæmaturia unless the growth encroaches upon the renal pelvis.

In a considerable proportion of cases however the first thing that is discovered is a tumour, and this is more especially the case in children. When the growth is situated in the lower part of the kidney or the kidney is movable, the tumour is discovered early. It is as a rule painless at first, but as it enlarges it tends to contract adhesions and causes a dull, aching pain from pressure, which is referred to the spine or some of the spinal nerves and closely resembles that due to spinal caries. Morris points out that the occurrence of a varicocele may be an additional aid to the diagnosis. The urine is but little altered in the early stages; later on, the urea may be markedly diminished in amount and pieces of malignant tissue may be found in it along with blood and blood-clot.

Cachexia and wasting soon become manifest. The kidney is often lobulated and the growth tends to spread along the pedicle, so that the mass may become adherent to the vena cava; it may also spread through the capsule and become adherent to the tissues around.

The diagnosis of renal tumours is often a matter of considerable difficulty and they have been mistaken even by the most experienced for tumours of the abdominal parietes, retro-nephric sarcomata, enlargements of the liver or the spleen, tumours of the supra-renal capsule, ovarian tumours, enlargements of the lymphatic glands, fæcal accumulations, appendicitic thickenings, malignant tumours of the large intestine, the mesentery or the omentum or enlargements of the gall-bladder. The main diagnostic point is that the large intestine is in front of the tumour, which is dull on percussion right back to the spine, and that there is no space behind a renal tumour into which the fingers can be pushed. The enlargement of the kidney may be due not to a tumour but to some other condition, such as stone, tuberculosis, polycystic disease, hydatid cyst, hydronephrosis, etc. All these points must be inquired into when making the diagnosis.

TREATMENT.—When a malignant growth of the kidney is suspected, *an exploratory incision* is quite justifiable, because malignant disease spreads very rapidly and the chance of successful extirpation soon disappears; if the enlargement turn out to be due to a calculus, a movable kidney or tuberculosis, it is all the better for the patient, while if it be due to early malignant disease it gives him the very best chance. In these cases a lumbar incision is generally the best; if it be necessary to incise the kidney in order to complete the diagnosis, the organ must be brought out on to the loin before this is done and carefully packed off with gauze. It is absolutely essential that no soiling of the wound should occur, for to cut into malignant disease and allow the cells and juices of the growth to spread over the wound is almost certain to cause dissemination of the disease; moreover, should there be pus in the kidney it is important to avoid infection of the wound. If the kidney be found to be the seat of malignant disease, the wound in it must be closely stitched up, fresh instruments obtained and the hands disinfected before proceeding to the nephrectomy.

The whole aim of treatment in these cases is total extirpation of the kidney, and this should be done when the organ is comparatively small and movable. When however there is advanced cachexia, and swelling of the lower extremities from pressure on the vena cava, or when the tumour is very rapidly growing, as it often is in young children, it is not worth while performing nephrectomy, because all chance of removing the disease successfully has disappeared.

Nephrectomy.—Unless the tumour be small, the lumbar operation is not very suitable, both because there is insufficient room and because it is not always possible to tell by means of it whether the kidney be removable. Whenever therefore the kidney is large, it is better to use one of the anterior

incisions, which may take the form either of a trans-peritoneal operation through the linea semilunaris or the linea alba, or an extra-peritoneal one outside the linea semilunaris.

Trans-peritoneal operation.—The patient lies flat upon the back, and an incision about five inches in length is made, with its centre opposite the umbilicus, along the linea semilunaris on the affected side; this incision can be enlarged upwards and downwards, as may be necessary. The peritoncum is opened throughout the whole length of the incision, and the intestines are carefully packed over towards the opposite side, and the condition of the pedicle of the kidney and the glands in the neighbourhood are ascertained before the operation is further proceeded with. If it be found that the



FIG. 53.—INCISION FOR EXTRA-PERITONEAL ABDOMINAL NEPHRECTOMY.

pedicle is not encroached upon by the growth and that the glands are unaffected, the operation is proceeded with by drawing the colon inwards towards the middle line and dividing the outer layer of the meso-colon about an inch external to the bowel over the whole length of the kidney. The peritoneum is then gradually raised forwards, carrying with it the colon, until the pedicle is reached. After having made sure that the kidney can be removed, the surgeon proceeds to isolate the pedicle and ties and divides the ureter in two places, securing the pedicle subsequently in the manner already described (see p. 230). The kidney can now be rapidly shelled out of its bed and removed through the abdominal opening, the wound being packed with sponges, while

the surface of the pedicle is examined to see if the vessels are properly controlled. All bleeding is arrested, the colon is replaced, and its meso-colon is stitched up. When there has been pus present in the kidney and there is consequently a risk of infection, the inner edge of the divided meso-colon may be stitched to the peritoneum on the inner edge of the abdominal incision at an early period of the operation, so that the main operation takes place practically extra-peritoneally. By this means a strip of peritoneum is shut off from the general peritoneal cavity, but that does not seem to be a matter of any importance.

Extra-peritoneal operation.—The operation that we prefer in many cases is extra-peritoneal, and is done by making a similar incision to the above about an inch and a half outside the linea semilunaris (see Fig. 53). It is carried down to the peritoneum, and then the latter is gently raised unopened and pressed inwards along with the colon, so that the whole operation may be performed extra-peritoneally. The subsequent procedure is identical with that described above.

The abdominal wall must be accurately sutured in both these operations, as otherwise a hernial protrusion will result. In order to avoid the possibility

of this, some surgeons advocate the lumbar incision, even in cases of extensive malignant disease. If a lumbar incision be used, it should be carried well forwards, and a vertical incision may be carried up from its posterior end, and the twelfth rib (or even in some cases the eleventh) may be excised. On the whole however we prefer one of the two abdominal methods.

The prognosis of nephrectomy in these cases depends, firstly, on whether the tumour be primary or secondary; secondly, on the period at which the disease is attacked; thirdly, on the avoidance of infection of the cellular tissue with the malignant disease during the operation; and, fourthly, on the absence of glands or extension of the disease beyond the true kidney substance. Success may be looked for in favourable cases of primary disease operated on early.

TUMOURS OF THE RENAL PELVIS.

MALIGNANT TUMOURS.—It is fairly common for malignant tumours to begin in the renal pelvis, and this form of growth so closely resembles malignant disease of the organ itself that nothing further need be said concerning its symptoms or treatment.

BENIGN TUMOURS.—*Papilloma* of the renal pelvis is sometimes found on incising the kidney for persistent hæmorrhage. The tumour may be a simple papilloma, or it may be associated with a malignant base. Even if it be simple, recurrence is very apt to occur, and papillomatous masses may spring up along the ureter or in the bladder. If there be any suspicion as to the true nature of the growth, the proper treatment is either to excise the base of the tumour freely, if there be sufficient room to do so, suturing the renal pelvis subsequently, or, if this prove impossible, to do a nephrectomy. The surgeon may deem the growth to be so obviously benign, however, that it is worth while in the first instance cutting the tumour freely away instead of excising the base widely. He will then wait to see whether the symptoms recur; should they do so, nephrectomy will be called for.

CYSTS OF THE KIDNEY.

The principal of these are simple serous cysts, hydatid cysts, and cystic degeneration of the kidney or polycystic disease. Dermoids have been met with, but they are extremely rare.

SEROUS CYSTS.—This is not a localised dilatation of one of the calices of the kidney, such as is met with in hydronephrosis, but is an independent cyst in the renal substance originating either as a retention cyst in a tubule from limited sclerosis or from the Malpighian capsules. The cysts are usually single, they may reach a large size, they may be situated anywhere in the organ and their contents vary much in character; the fluid is generally clear and slightly straw-coloured, containing a little

albumen and salts with very little or no urea. They usually give rise to no symptoms until a definite tumour is formed, when they are easily detected, but may be mistaken for a hydronephrosis.

Treatment.—Puncture has been recommended, but it is almost certain that the cyst will re-fill, and the proper line of treatment is either excision of the cyst or incision and drainage. If the cyst be small and single, the simplest plan is to excise it along with a thin layer of the renal perenchyma as the cyst is not easy to shell out. The bleeding resulting from this is easily stopped by passing deep sutures through the renal tissue (see p. 191). The ordinary lumbar incision is the best (see p. 178). When the cyst is very large it may be considered preferable to lay it freely open and stitch the cut edges to the skin, and establish a fistula after sponging the surface of the cyst wall over with undiluted carbolic acid. Healing will take place after a time, but this method is distinctly inferior to excision if that be possible. Primary nephrectomy is quite unnecessary, but it may occasionally happen that a permanent urinary fistula is established in the loin, and for the cure of this the patient may insist on a secondary nephrectomy.

HYDATID CYSTS.—These occur comparatively rarely, and follow the same course as hydatids elsewhere. The affection is usually not noticed until a tumour of considerable size has formed, unless the cyst bursts into the renal pelvis, when there will be attacks of renal colic and the passage of small “daughter-cysts.” The diagnosis is often extremely difficult. If the cyst has burst into the pelvis, “daughter-cysts” will be passed; if the tumour be punctured, examination of the fluid will reveal its nature.

Treatment.—This consists in stitching the cyst wall to the skin, drawing off as much of the fluid contents with a trochar and cannula as possible, and then laying the cyst freely open, washing out the cavity, and removing its contents; a drainage tube is inserted, and the cavity is irrigated daily with boracic lotion to remove any shreds of the cyst wall that have become detached. Occasionally, when the cyst is very small, it and the adjacent portion of the kidney may be excised, just as for simple serous cysts (*vide supra*) and this is followed by immediate and complete recovery; these cases however are rare.

CYSTIC DEGENERATION OF THE KIDNEY.—This is also known as polycystic disease of the kidney, and is not amenable to surgical treatment. It is practically always bilateral although it is more advanced on one side than on the other. The cysts are very numerous, and the only really radical treatment is nephrectomy. As the disease advances symptoms of degeneration of the kidney set in and the patient usually dies of uræmia. It has been suggested that the kidney in which the disease is most advanced should be removed, but this, at any rate in some cases, has apparently been followed by a rapid increase in the degeneration on the other side. Mr. Henry Morris however is inclined to recommend a

nephrectomy in cases of polycystic disease, in which, after opening the peritoneum, the opposite kidney appears to be only very slightly affected, and where the condition on the affected side is very advanced. The disease is often only discovered during life after an exploratory operation and then frequently the only question that arises is the advisability of opening some of the cysts so as to get diminution of the tumour; in one case Morris got great temporary relief by doing so.

PERI-NEPHRIC CYSTS.—These are extremely rare and are usually only diagnosed after operation. They presumably result from hæmorrhage outside the kidney.

PERI- AND PARA-NEPHRIC TUMOURS.

PARA-NEPHRIC TUMOURS.—Tumours of the supra-renal capsule are not very uncommon, and are generally malignant adenomata presenting the characters of supra-renal tissue. It is impossible to diagnose them from primary tumours of the kidney, although a suspicion of their true nature may be excited by the rapid loss of flesh, the bronzing of the skin, the marked gastro-intestinal symptoms, the pain referred to the tip of the shoulder, and the rapidity of growth; there is no hæmaturia.

Treatment.—This is the same as that of a renal tumour of a similar nature. In the first place the growth must be explored, and the kidney should be excised as well as the tumour, because a growth of any size will almost certainly have affected the organ, and recurrence will take place speedily if it be left behind. In some rare cases a partial nephrectomy, *i.e.* excision of the upper part of the organ with the adherent supra-renal capsule, may suffice. This point can only be determined at the operation.

PERI-NEPHRIC TUMOURS.—Many varieties of peri-nephric tumours may be met with in the cellular tissue around the kidney, of which fibroma, lipoma and sarcoma are the commonest. All these tumours are not necessarily peri-renal in origin, as sarcomata may grow from the kidney capsule, and probably do so in the majority of instances.

The diagnosis is very difficult, and the case will generally be considered to be one of renal tumour; the absence of hæmaturia is an important although not a pathognomonic sign. The exact diagnosis is only made by a lumbar or a lateral abdominal incision, and the treatment will depend upon whether the kidney be invaded. If the tumour be benign, it should be shelled out if it be possible to separate the kidney and the ureter from it. A sarcomatous tumour will generally require to be removed along with the kidney if there be adhesion of the latter to it. If there be only slight adhesion to one part of the kidney that portion of the organ alone may be excised along with the tumour. All these tumours are comparatively rare, and those interested in the subject should consult some special work on the subject.

SECTION II.—AFFECTIONS OF THE BLADDER.

CHAPTER XXV.

GENERAL METHODS OF DIAGNOSIS.

WHEN examining a case of suspected disease of the bladder the first point is to make sure that the disease affects that organ, as diseases occurring elsewhere in the urinary tract may give rise to symptoms that on superficial examination may be mistaken for those of an affection of the bladder; the second point is to ascertain the nature of the disease. The diagnosis of vesical affections is arrived at by a consideration of the symptoms present, by examination of the urine, and finally by various methods of vesical examination.

The symptoms will be dealt with more fully in connection with the individual diseases; here we shall merely indicate their general significance. The most important are alterations in the act of micturition.

Frequency of micturition is common to most bladder affections, but it also occurs when the bladder is healthy; for example, it is a common symptom of renal stone, especially when the latter is trying to pass down the ureter. It is a characteristic symptom of certain diseases of the prostate; it is met with in dyspeptics who pass large quantities of oxalates or in gouty persons who pass abnormal quantities of uric acid, and it also occurs in the subjects of hæmorrhoids, hypochondriasis, hysteria, diabetes, and some diseases of the spinal cord, etc. Hence this symptom alone does not imply a morbid condition of the bladder.

In estimating the value of this symptom it is important to ascertain under what circumstances it is most marked; for instance, if it occurs during the night, it is strong presumptive evidence in favour of enlargement of the prostate, whereas, if the contrary be the case, it points to the presence of a calculus in the bladder or to some nervous affection. When it is increased by exertion it points to a renal or a vesical calculus, and this view will be confirmed if rest in the dorsal position causes diminution in it, as rest has no

effect in tuberculous affections of the bladder. Frequency of micturition is practically always met with when the mucous membrane of the bladder is inflamed.

Urgency of micturition is an important sign. When the healthy bladder becomes distended, the desire to empty it can be resisted for some time ; but in pathological conditions this is impossible, and the patient is compelled to empty the bladder the moment he experiences the desire to do so. Sometimes this symptom is accompanied by increased frequency, and the patient complains that his water is constantly running away, and thinks that he has incontinence ; this is common in the so-called "irritable bladder," and is often termed "false incontinence" in contra-distinction to the true form in which the urine escapes as fast as it is secreted. Urgency of micturition, although strong presumptive evidence of an inflammatory condition of the bladder, is not absolutely pathognomonic, as it is met with in spinal disease, in dyspeptics, and in prostatic conditions even without cystitis.

Difficulty in micturition usually points to interference with the outflow of urine, and is therefore a usual accompaniment of stricture of the urethra, or of that form of prostatic enlargement in which one portion of the gland enlarges and blocks the neck of the bladder.

Painful micturition is perhaps of the least value as far as the diagnosis of bladder affections is concerned, as it may not be due to trouble in the bladder at all, and is a frequent symptom of disease of the urethra or prostate or of affections outside the bladder altogether. When due to vesical disease it may be so bad as to make life intolerable, while, on the other hand, it may be very slight indeed, although the affection with which it is associated may be of the gravest importance. A study of this condition may occasionally lead to a correct diagnosis, as, for example, when the pain is not merely associated with micturition, but occurs in the bladder or penis after exertion and is entirely arrested by rest or by micturition in some unusual position, such as the dorsal, when it is almost pathognomonic of vesical calculus. If it be neuralgic, erratic in its onset, independent of movement and associated with deficiency in the outflow of urine, locomotor ataxia is probably its cause. The situation of the pain is of little importance. Some help may be obtained by ascertaining the precise time during the act of micturition at which the pain comes on. Pain at the commencement of the act is generally due to some obstruction to the outflow of urine ; when it occurs during the act it is often caused by an acute urethral inflammation or by inflammation of the bladder in which the contraction of the inflamed bladder wall is extremely painful ; when it occurs at the end of the act it is usually associated either with stone or with some inflammation at the neck of the bladder or the prostate, and is caused by contraction of the sphincter vesicæ upon the inflamed structures.

Alterations in the character of the urinary stream are generally indicative of some obstruction either in the urethra or in the prostate. If the stream be forked, twisted or much diminished in calibre, while it remains normal in

force, it generally indicates stricture of the urethra near the meatus; on the other hand, a stream normal in calibre but diminished in force is strongly suggestive of prostatic enlargement. Should the stream of urine be constantly interrupted during micturition and should this be accompanied by sharp pain, the suspicion of a stone in the bladder is very strong.

Incontinence of urine may be either true incontinence, when the urine dribbles away as fast as it is secreted, or a form of "false incontinence" which is really retention with overflow, that is to say, a condition in which there is an obstruction causing retention, so that the bladder becomes overfull and after a time the urine dribbles away. In this condition the bladder is always full whereas in true incontinence it is always empty.

Examination of the urine is very important in the diagnosis of bladder affections. From forty-five to fifty-five ounces are passed in the 24 hours by a healthy subject and if this amount be markedly altered there is probably some renal affection present. Its normal specific gravity is 1018-1022 and this is constant in all diseases of the bladder; if it undergo marked change it implies disease of the kidney. A diminution in specific gravity in cases of disease of the bladder points to the presence of pyelitis or pyelo-nephritis.

Turbidity of the urine is generally met with in bladder affections and is most often due to cellular elements resulting from vesical catarrh, but it may be due to a deposit of urates or phosphates, the latter being caused by decomposition of the urine and disappearing on the addition of dilute acetic acid; turbidity due to catarrhal secretion is not affected by the addition of acetic acid. Ammoniacal fermentation is generally due to vesical catarrh accompanied by paresis or retention. Foul-smelling urine is very likely to be due to ulcerating growths in the bladder, whilst a feculent smell may indicate communication between that organ and the intestine, but may also occur in connection with purulent collections outside the bladder bursting into the latter without any connection with the bowel.

Normal urine has a feebly acid reaction, but when there is disease of the bladder with ammoniacal decomposition the reaction becomes alkaline. It must not however be assumed that acid urine containing pus cannot come from the bladder, or conversely that alkaline urine may not come from the kidney. Ammoniacal decomposition in the bladder usually occurs after the passage of dirty instruments, and crystals of triple phosphates and numerous bacteria are generally found. In true phosphaturia both triple phosphates and bacteria are absent. If pus or blood be present in the urine, there will be albuminuria in proportion to the amount of these present; in disease of the kidney on the other hand, the albumen is present in a much larger proportion than is accounted for by them. It must however always be remembered that bladder diseases may be accompanied by albuminuria of renal origin.

Hematuria is a common occurrence in bladder affections, but the blood may also come from the urethra, the prostate or the kidney. When it derives its origin from the urethra in front of the membranous portion, the blood

drips from the meatus independently of micturition and the urine is clear after the first few drops of urine have been passed. Bleeding behind the membranous portion however cannot find its way out on account of the contraction of the muscles and it therefore travels backwards into the bladder. If the hæmorrhage be slight, the blood only appears in the first portion of the urine or sometimes at the close of the act of micturition, the rest being clear. When it is profuse however, a considerable quantity may find its way into the bladder and the whole urine is uniformly tinted. Clots taking the shape of the prostatic urethra indicate bleeding from the neck of the bladder or the prostatic urethra, as does also a large amount of blood at the end of the act.

When the blood comes from a vesical ulcer, it is intimately mixed with the urine. A test suggested for ulceration of the bladder is to inject a solution of iodide of potassium into the bladder cavity and to test the saliva with starch solution for the presence of iodine about ten or fifteen minutes afterwards. A normal bladder does not absorb at all and absorption only takes place from an ulcer on its surface; if therefore the saliva shows signs of iodine it indicates a breach of surface in the bladder through which absorption has occurred.

Pyuria is very common in bladder affections but is also met with in diseases of the urethra and the kidney. Pus from the urethra behaves much as does blood from the same region. When the urine contains threads or clumps they are always urethral in origin, generally from the neighbourhood of the prostate. If the pus be due to urethritis and the urine be passed into three separate glasses the first portion is always more turbid than the second, whilst the last portion is quite clear. On the other hand, pus from the bladder makes each portion of the urine equally turbid; possibly the last portion may be even more markedly affected than the earlier ones on account of a collection of pus behind the prostate.

It is not so easy to determine whether the pus comes from the kidney or the bladder. In the former case there is more albumen than the amount of pus warrants, and there will be polyuria of a low specific gravity with renal casts and epithelium. In pyuria of vesical origin the specific gravity of the urine is unaltered, the amount of albumen is slight, and corresponds only to the amount of pus present, and there is often ammoniacal decomposition; no renal casts are found, but bladder epithelium may be present. Bladder epithelium varies a good deal according to the layer from which it is derived; that from the superficial layer varies much in form and size, but is more or less flattened; that from the middle layer consists of polygonal cells, whilst that from the deeper one is of irregular oval cells. The epithelial cells from the renal pelvis are often tailed. A very valuable method of clearing up the diagnosis in hæmaturia of doubtful origin by washing out the bladder has already been described (see p. 171).

Inspection of the abdomen seldom gives any information except when the bladder is much distended, when a median ovoid tumour with its narrower end downwards may be seen extending upwards towards the umbilicus.

Percussion only gives imperfect information. It must be remembered that in the female the bladder soon becomes an abdominal organ, and therefore a moderately distended bladder may be readily made out by percussion. In the male however the organ passes more backwards into the pelvis, and does not project upwards into the abdomen until it is considerably distended, and therefore much more importance should be attached to the presence of a hypogastric swelling in these cases. This is especially the case in subjects of enlargement of the prostate.

Palpation of the bladder may be valuable, but is of little use in fat subjects. The thighs should be flexed so as to relax the abdominal muscles, and the palpation is practised by placing the hand flat upon the abdomen just above the symphysis while the patient breathes deeply with the mouth wide open. The ulnar border of the hand is pressed as far into the pelvis as possible, and distension of the bladder can thus be easily made out in thin people. The bladder may also be pushed up towards the hand upon the abdomen by the forefinger of the other hand introduced in the rectum or the vagina. If the bladder be inflamed, palpation will elicit tenderness, while the manipulation may give rise to free bleeding in the case of a villous tumour. In very spare subjects bi-manual palpation practised thus may enable the whole of the bladder to be examined, and stones, tumours, or other enlargements may be recognised. The palpation should be begun without an anæsthetic in order that tenderness may be recognised if present, but it should be completed under general anæsthesia after the bladder has been emptied. This examination gives very satisfactory results indeed in the female, and the ureters may also be felt through the vagina if they be thickened or contain a stone.

Instrumental examination.—The information derived from the use of *catheters* is often highly important. If the patient empties his bladder and a catheter be passed immediately afterwards, the question whether “residual urine” is present can be definitely settled. Moreover the character of the flow through the catheter may throw light upon the condition of the vesical walls; if the urine be expelled in a good stream, the musculature of the bladder is vigorous, whereas if it simply escapes by gravity the bladder is atonic. In many cases it is well to test the distensibility of the organ while the catheter remains in the bladder. If large quantities can be injected without exciting contraction, atony or paralysis is present; if on the other hand only half an ounce or so can be injected without exciting expulsive efforts, there is the condition present known as “irritable bladder” due to some form of cystitis, and this will be further evidenced by the presence of pus in the urine. If however there be pyuria with normal bladder distensibility it is strong evidence that the pus is of extra-vesical origin, and has not yet given rise to cystitis. It is an important fact to bear in mind that even general anæsthesia does not increase the distensibility of the bladder when chronic cystitis is present.

When there is a suspicion of villous tumour of the bladder, it is well before withdrawing the instrument to inject two ounces of fluid and allow it to flow out, and then to withdraw the catheter as the last drops are being expelled.

The eye of the catheter should then be flushed out into a separate dish so as to see whether any material has been withdrawn by it. With a villous tumour situated near the neck of the bladder it is very common to find villi washed into the eye of the catheter with the escaping fluid, and torn off as the catheter is withdrawn. Some surgeons even attach an evacuating syringe to the catheter in order to suck villous processes into its eye. This is a most useful manœuvre if practised with a metal catheter in cases of suspected stone which the sound fails to detect. As the stone is drawn up against the eye of the catheter it gives the sharp characteristic click which cannot be mistaken.

The *sound* will often give very valuable information. The most suitable instrument is a short-beaked bulbous-ended metal one at least fourteen inches long (see Fig. 54). The patient lies upon his back on a couch with the pelvis raised, and, if he be nervous or very young, the sounding should be done under a general anæsthetic as it is most essential that no movement should interfere with the exploration. The sound, sterilised by boiling, is lubricated with eucalyptus or carbolised vaseline and, before it is passed, the orifice of the urethra is disinfected with a pledget of wool dipped in a 1-2000 sublimate solution. Before a systematic sounding a catheter should be passed, the urine drawn off, and the bladder washed out and finally distended with three or four ounces of warm boracic lotion; this is very important, both to enable the beak of the sound to turn easily in all directions, and also to prevent the folds into which the mucous membrane of the collapsed bladder falls from interfering with the examination. When the sound has been introduced, the exploration must be systematic so as to explore the entire interior of the organ; this is described elsewhere (see p. 299). The sound will detect the presence of a stone, any roughness of the bladder wall, and sometimes the presence of a tumour.



FIG. 54.—BLADDER SOUND.
The position of the beak is known by a glance at the mark affixed to the handle.

Under certain circumstances the most valuable method of examining the bladder is by direct inspection with the electric *cystoscope* (see Fig. 55). The form in general use is that of Leiter. The instrument should be carefully tested before use to see that it is in working order, and the examination should be

made either under local or general anæsthesia. If the case be one of irritable bladder the patient should certainly have a general anæsthetic, and on the whole general anæsthesia is perhaps advisable; when there is an objection to this however, local anæsthesia will often serve, and the best plan then is to wash out and empty the bladder completely, and to introduce two or three ounces of a 2 per cent. solution of eucaine into it. This is left *in situ* for about five minutes, when the solution is drawn off and warm boracic lotion or sterilised water is introduced in its place. If the bladder be at all irritable, some eucaine should be introduced into the deep urethra as well. There is no risk of absorption of the drug unless there be extensive ulceration of the bladder, and the solution be left too long *in situ*. The patient should lie upon his back upon a table or high couch, with the legs hanging over the end, and it is of advantage to raise the pelvis slightly upon a sandbag or a pillow.

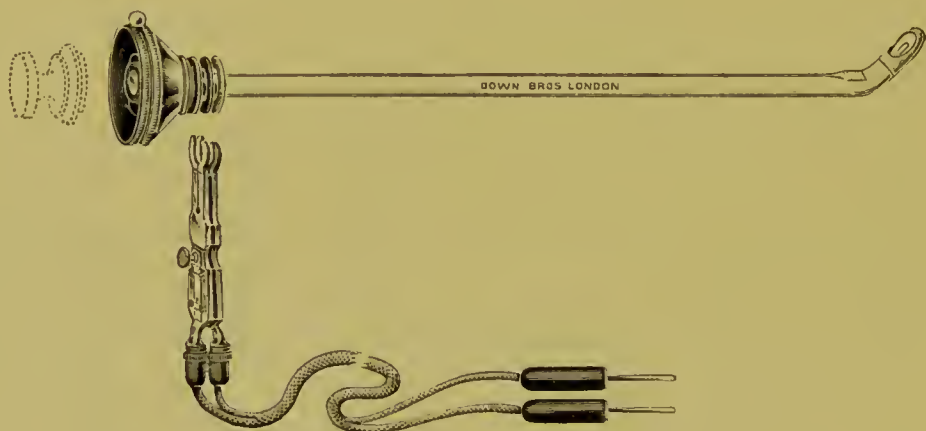


FIG. 55. - ELECTRIC CYSTOSCOPE. The position of the beak is indicated by the small ivory knob on the eye-piece.

The bladder is washed out immediately before examination until the lotion returns quite clear, and its cavity is distended with four or five ounces of warm boracic lotion; the catheter is now withdrawn, the penis being grasped to prevent the fluid escaping. It is essential not to lubricate either the catheter or the cystoscope with a greasy material, as otherwise the window of the cystoscope will be obscured; we use glycerine or boro-glyceride.

When the cystoscope has been introduced into the bladder, care must be taken that the current is not turned on until the instrument is felt to rotate freely in its interior. The instrument with the window in the elbow of the beak (see Fig. 55) is first introduced, the one with the window at the opposite angle being only employed for examination of the posterior wall. A systematic examination of the interior of the bladder should be made. The cystoscope is pushed in as far as it will go, the light is switched on, the instrument is held in the middle line with the beak turned backwards, and the handle is gradually raised so as to bring successive portions of the bladder into view, the whole instrument being gradually withdrawn until the beak lies near the neck of the bladder; it is then pushed back into

its former position and its point is deflected, first to one side and then to the other, at an angle of about 45° from the median vertical plane, and the same procedure is repeated. Finally the outward deflection is still further increased to about 90° , and thus the whole interior of the bladder, with the exception of the region of the apex, may be inspected. At fairly short intervals it is well to switch off the light and to suspend the examination for a few moments in order to allow the instrument to cool, as it heats somewhat readily and, if the patient be under an anæsthetic, considerable irritation of the bladder walls may thus be produced. If it be desired to complete the examination by inspection of the apex, the second form of instrument is introduced; this has the prism on the outer aspect of the elbow, and the apex is examined by somewhat depressing the handle and sweeping the beak from side to side.

The normal vesical mucous membrane is smooth and pink, with the superficial vessels showing distinctly, and the openings of the ureters standing out as small prominences with a connecting ridge between them. Urine, pus or blood may, under certain circumstances, be seen issuing from one or both of these orifices.

A large number of pathological conditions—such as ulcers, new growths, stones, cicatrices, fistulæ, etc.—may be made out by direct inspection in the most satisfactory manner, but there are various difficulties connected with the use of the cystoscope. It is most tedious in cases accompanied by marked hæmaturia, as it may be impossible to render the contents of the bladder sufficiently clear for a reliable view to be obtained, and in some cases of vesical tumour the mere introduction of the instrument leads to increased bleeding and defeats the object of the examination, although this fact alone may give valuable diagnostic information. The instrument must be most carefully introduced, as, if there be any congestion of the prostate, it may give rise to hæmorrhage, as it passes into the bladder, and the window of the instrument may become coated with blood-clot so that no view can be obtained; the examination had then better be postponed.

Although the instrument may give information of great value, it often fails, and its use is not always essential, as the other symptoms present may suffice for the diagnosis. In some cases indeed, such as enlarged prostate, it may be actually harmful and can do little good as a method of diagnosis. In stone in the bladder it is not likely to be very useful, except in cases of encysted calculus, when it is of great value. Its most useful function is perhaps the examination of the ureteral orifices (see p. 169), as an aid to the investigation of the condition of the kidneys.

Attempts have been made to combine with the ordinary cystoscope means of removing small villous tumours, scraping ulcers, etc., but these are not of much value. It is possible however, by the use of special instruments, to cauterise ulcers of the bladder under the illumination of a cystoscope, and this ought to be valuable. Some surgeons also have acquired enough skill to introduce a catheter into the ureteral orifices through a special cystoscope (see Fig. 56).

In the female a larger-sized cystoscope may be employed, and a more satisfactory examination of the bladder may thus be obtained ; but on the

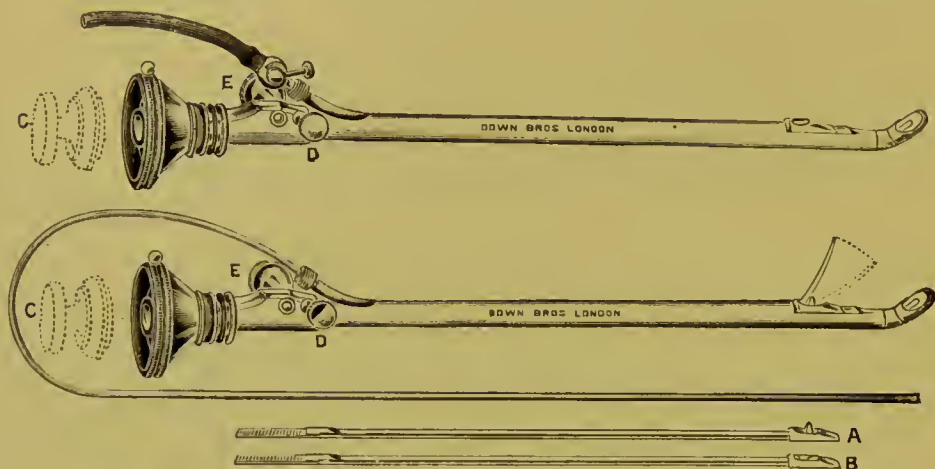


FIG. 56.—NITZE'S CYSTOSCOPE FOR CATHETERISATION OF THE URETERS. The upper figure shows the instrument fitted with the tube *B* for washing out the bladder. The lower one shows how the ureteral catheter is passed along the tube *A*, which has been made to replace the tube *B*. The direction of the point of the catheter is altered by turning the screw *E*.

whole, if an exhaustive examination be required, the better plan is to use *Kelly's tubes* (see Fig. 57), for which general anaesthesia should be employed, as the urethra has to be fully dilated ; without it moreover the patient would undoubtedly object to the complete exposure that is necessary for the

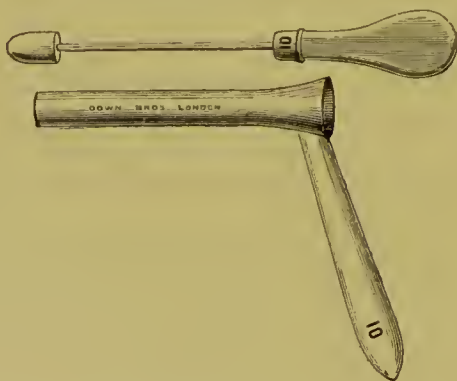


FIG. 57.—KELLY'S FEMALE BLADDER SPECULUM. The tubes are of different sizes and resemble the rectal specula (see Fig. 5).

examination. If the patient be very stout, the knee-elbow position should be adopted ; otherwise an exaggerated lithotomy position suffices. The first step is to dilate the urethra fully so as to introduce a large-sized tube ; the dilatation may be begun with Hegar's dilators, and is completed by introducing either the finger or the largest-sized urethral speculum (see Fig. 58). The largest-sized Kelly's tube that can be introduced is then passed and the obturator withdrawn, when the bladder at once fills with air ; it is useful to introduce two fingers into the vagina, so as to distend it with air also, when the posterior vesical wall becomes projected well forward. Any urine that has not been drawn off escapes through the tube, and the last few drops are mopped up with pads of cotton wool. The orifices of both ureters, the whole of the posterior wall and the greater part of the interior of the bladder, can now be inspected easily by moving the tube gently over the mucous membrane, mopping up the surface exposed and inspecting it by means of a forehead light. If the inspection be not satisfactory with the patient in the

lithotomy position, the knee-elbow one may be employed, and the posterior wall of the bladder may be rendered still further accessible by pushing it forward with a pad of wool in the vagina. By means of these tubes the examination of the ureters can be carried out with ease, as each ureteral orifice is brought into view in the centre of the field in turn, and a probe or catheter can be passed through the orifice, so that not only can the direction of the ureter be located in cases of operations upon it, but urine may be withdrawn directly from the pelvis of the kidney and accurately analysed. A

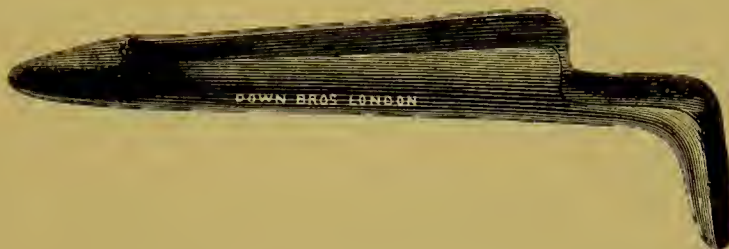


FIG. 58.—DILATING SPECULUM FOR THE FEMALE URETHRA.

similar principle has been applied to the male bladder through a perineal wound, but this is much more difficult and dangerous, and only few can carry it out ; in the female however it is comparatively easy.

Digital examination of the interior of the bladder can also be practised in the female, and of course also in the male through a perineal wound ; in the latter case however it is rarely practised for mere exploratory purposes. It is easy to dilate the female urethra so as to admit the forefinger, and then bi-manual palpation with the forefinger of the other hand in the vagina will allow the greater part of the interior of the organ to be examined. The dilatation of the urethra must be carried out very gently and gradually, and the sphincter vesicæ must not be torn. There is usually some incontinence of urine after it, but this is soon recovered from, and in some cases is not present at all. It may even be necessary to nick the external meatus in order to allow the dilatation to be carried to its full extent, but this is a matter of slight importance. If digital examination of the interior of the bladder be required in the male, the best method is to perform a supra-pubic cystotomy, as this at once lays bare the whole interior of the bladder both to touch and to sight. The operation is described elsewhere (see p. 289).

CHAPTER XXVI.

CONGENITAL ABNORMALITIES OF THE BLADDER.

EXTROVERSION OF THE BLADDER OR ECTOPIA VESICÆ.

THE frequency of this condition is variously estimated by different authors ; it is said to occur in one out of every six thousand births. It varies from complete absence of the anterior wall of the bladder and of the abdominal wall in front of it, together with wide separation of the pubic bones, down to a small defect in the region of the neck. In the male, complete epispadias and a rudimentary penis are usually associated with it, while in the female the urethra may also be split. It is apparently more frequent in the male than in the female, and in the former the testicles may be imperfectly descended, and congenital hernia is not uncommon.

In a complete extroversion the red fleshy mucous membrane of the posterior wall of the bladder protrudes beyond the surface of the abdomen with the ureteral orifices leaking urine below. There is always ammoniacal decomposition of the urine, with irritation and ulceration of the skin around, phosphates are deposited upon the latter, while the exposed mucous membrane becomes inflamed and hypertrophied, bleeds readily and is often papillomatous and ulcerated. Behind the protruding mucous membrane is a very defective muscular coat, so that practically nothing intervenes between it and the peritoneum but a little loose cellular tissue, and hence great care has to be taken in operating not to open the peritoneal cavity. The patient may live for a long time, but it is more common for death to occur from sepsis spreading up the ureter.

TREATMENT.—Something must be done, as the condition is most distressing and is likely to prove fatal, and attempts at treating it by merely palliative means, such as collecting the urine in an apparatus designed to protect the mucous membrane from irritation, have proved abortive, as escape of urine by the side of it is almost certain to occur. The operative measures may be divided into two main groups ; in the one case an attempt is made to form a cavity in the usual situation to take the place of the bladder,

whilst in the other the urine is diverted into the vagina in the female or into the sigmoid flexure in the male by transplanting the orifices of the ureters.

Plastic operations upon the bladder.—Unfortunately the result of even the most successful of these is only palliative, as it is impossible to provide a fresh sphincter to the bladder so as to enable the patient to retain his urine. It sometimes happens that as much as three or four ounces may be retained in the freshly-formed cavity, but this is always liable to escape, and there is no true control over it. At the same time however a successful operation of this kind is very valuable as in the first place it protects the mucous membrane from irritation and so relieves the suffering enormously, whilst in the second place it enables a well-fitting urinal to be worn and this increases the comfort of the patient. Hence, whatever else is done, some attempt must be made to cover in the exposed mucous membrane.

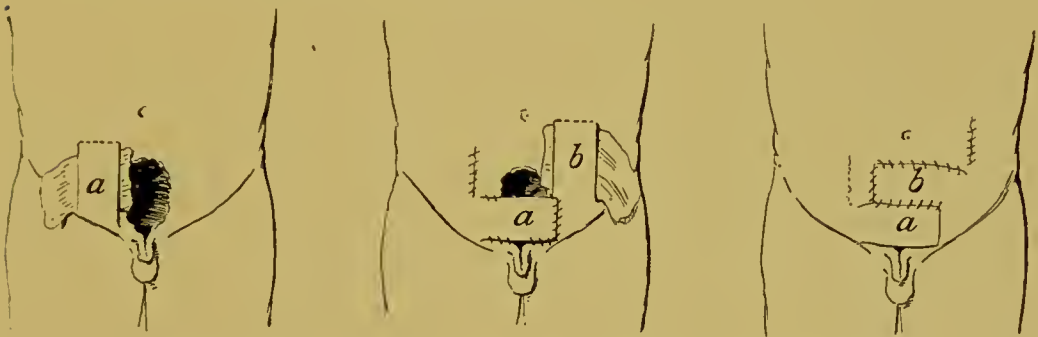


FIG. 59.—THIERSCH'S OPERATION FOR EXTROVERSION OF THE BLADDER. *A* shows the first flap, *a*, shaped but not completely detached. Protective or gold-beater's skin is placed beneath it until granulation is complete, when it is divided along the dotted line and turned down into place, as shown in *B*, where the second flap, *b*, is also shown. This is turned into position as in *C*, and then nothing remains to be done except to remedy the epispadias.

Wood's operation.—This consists essentially in turning down a flap from the front of the abdomen with its base close to the upper margin of the protruded mucous membrane and its cutaneous surface looking towards it. The raw outer surface of this flap is covered by two lateral flaps made to slide in from the side and meet in the middle line. This operation, although successful in closing the cavity to a certain extent, is open to the great objection that hairs will grow from the reflected skin, and upon them phosphatic concretions will constantly occur, and prove an unending source of trouble; it is seldom used at the present time.

Thiersch's operation.—A modification of Wood's method is to close the bladder by flaps having their raw surfaces turned towards the bladder, but the difficulty has been to avoid sloughing in the long flaps necessary for the purpose. This difficulty Thiersch has tried to avoid by cutting a flap of proper size, undermining it, and leaving it attached at both ends for some days until granulation of the raw surface has taken place completely (see Part I., p. 180), when one end is completely detached and the flap is turned into place. When this has united, a second flap is fashioned if necessary, and so on until the anterior surface of the bladder is restored (see Fig. 59); finally

the epispadias is also cured. Several cases operated upon by this method have given fairly satisfactory results.

Trendelenburg's operation.—Another method has been introduced by Trendelenburg which aims at diminishing the gap in the anterior abdominal wall by approximating the separated ends of the pubic bones. This is done by dividing the posterior ligaments of the sacro-iliac synchondrosis on each side, and is only applicable to very young children before ossification is advanced. The main points of the operation are as follows: The patient is turned over almost on to the face, and an incision is made over one sacro-iliac synchondrosis, the joint fully exposed and the posterior ligaments divided as freely as possible. While this is being done, an assistant makes firm pressure over the crest of the ilium on each side and this keeps the parts on the stretch and renders the detection of undivided bands easy. When one joint has been thoroughly divided in this manner, a similar procedure is carried out on the opposite side, until both innominate bones can be pushed inwards sufficiently to allow the pubic bones almost to touch in the middle line. The posterior wounds are then closed in the usual manner, and a short interval is allowed to elapse before proceeding to the second part of the operation, the patient being meanwhile placed in an apparatus so arranged that pressure is applied over each side of the ilium and the great trochanters, so as to push the innominate bones inwards. This reduces the defect in the anterior abdominal wall very greatly, and the prolapsed mucous membrane recedes and a deep furrow is left, over which the soft parts can be brought without any great tension.

In about a fortnight's time the second stage is proceeded with by making an incision at the point of junction of the skin with the mucous membrane all around the defect in the bladder and dissecting up the mucous membrane from the peritoneum for a short distance. The greatest care is necessary in doing this as the peritoneum is in close contact and may easily be wounded. The edges of the mucous membrane, which should then come together easily, are united by a continuous catgut suture, and it only remains to undermine the skin all round with a few sweeps of the knife and to unite the raw edges with silkworm gut sutures in the middle line. The operation for the cure of the epispadias should be deferred to a later period and for choice should be that recommended by Thiersch (see Epispadias).

The results of this operation are on the whole better than those of the flap methods, but it is absolutely necessary that the operation should be carried out in early life, as the pliability of the parts is lost as soon as ossification has advanced.

Attempts have been made to detach the mucous membrane of the bladder from the peritoneum all round sufficiently to bring it together and suture it in front of the ureters without dividing the sacro-iliac ligaments, but the difficulty is in the first place to separate the mucous membrane from the peritoneum without damaging the latter, while in the second place the vascular supply of the mucous membrane is feeble, and sloughing may occur. The plan however has proved successful and may be employed with advantage

for the minor degrees. The second stage of the operation consists in sliding in flaps with their raw surface downwards to cover the united mucous membrane.

Transplantation of the ureters.—This plan has been much recommended and the ureters have been transplanted either into the vagina or into the sigmoid flexure or upper part of the rectum, whilst the mucous membrane of the bladder is dissected out completely. The retentive power is better if the ureters be transplanted into the sigmoid flexure, as that organ is capable of holding a certain amount of urine whereas it continually dribbles away from the vagina. The great objection to transplantation into the bowel however is the risk of septic infection spreading up along the ureter, but experience shows that this risk is much diminished when the ureteral orifices are bodily transplanted and from this point of view the operation is therefore much less dangerous than when the ureters are divided before they reach the vesical mucous membrane; the valvular orifices of the ureters appear to be able to a certain extent to prevent the passage of infective material upwards.

The operation has already been described (see p. 200). The actual grafting is preceded by detaching the mucous membrane of the bladder bodily from the peritoneum from above downwards after the most careful disinfection; and when this has been carried down close to the ureters, the peritoneum is divided and the former are traced down to their entrance into the bladder and the vesical mucous membrane is clipped away entirely except in the immediate neighbourhood of the ureteral area. A loop of the sigmoid flexure is then brought out on to the abdominal wall, the peritoneal cavity is carefully packed off and clamps are applied to the upper and lower part of the loop of bowel, the intermediate portion being emptied by pressure before the second clamp is applied. A longitudinal incision is now made into the bowel nearly corresponding in length to the strip of mucous membrane containing the two ureteral orifices and this strip is inserted into the interior of the rectum with the left ureter uppermost and secured in place by a double row of sutures, the deeper one being of catgut and uniting the mucous membrane of the bladder to the whole thickness of the intestine, whilst the superficial one brings together the peritoneal coat of the bowel over the transplanted portion. The abdomen is then closed in the usual manner.

This operation has also been done extra-peritoneally by Peters of Toronto.¹ He begins by dilating the sphincter, washing out the rectum with an antiseptic, and plugging the bowel as high up as possible with a sponge to which a tape is attached. A No. 5 Jaques's soft rubber catheter, cut obliquely above the eye so as to facilitate the entry of the urine, is now passed for about two inches into each ureter and kept in place by a stitch or two through the ureteral papilla. A circular incision is next made through the bladder wall around each ureter and deepened until the ureter is exposed, leaving the

¹ *British Medical Journal*, June 22, 1901.

papilla intact, and a considerable length of the ureter can now be exposed with a blunt dissector without injuring the peritoneum. When this has been done, the rest of the bladder mucous membrane is completely removed. The next step is to introduce a finger into the rectum and to project it towards the lower part of the wound where, with a little dissection, the sides of the rectum can be exposed. A pair of sinus forceps passed through the anus is made to project against the lateral wall of the rectum at a point which the ends of the ureters can be made to reach without any traction and a small incision, just sufficient to admit the ureter, is made upon their points. The blades of the forceps are then pushed through, the opening if necessary slightly dilated, the end of the catheter is seized and it and the orifice of the ureter are pulled down into the rectum, the end of the catheter hanging out of the anus. This is done on both sides. Peters does not employ any stitches because the opening in the rectal wall just admits the ureter without constricting it and the mucous membrane at the end of the ureter prevents retraction. The wound is packed with iodoformed gauze; the catheters come away in about 60 hours. In the patient on whom Peters operated the result was remarkably good.

CONGENITAL PATENCY OF THE URACHUS.

This condition is much rarer than that of extroversion and in it the urine generally escapes through the umbilicus. The rest of the urinary apparatus with the exception of the portion between the fistulous opening and the bladder may be quite normal. The patient has practically a cutaneous urinary fistula.

TREATMENT.—If a probe shows that the urachus between the fistulous opening and the apex of the bladder is pervious, an attempt may be made to pare the fistulous opening and to bring the edges both of the urachus and the abdominal tissues together so as to give a firm union and close the fistula. Should this fail or should the lower portion of the urachus not be pervious, the fistulous track must be dissected out and the opening into the bladder inverted and closed by Lembert's sutures.

In some cases the bladder is projected up like a cone; here excision of the apex of the cone followed by inversion and suture of the edges is the proper practice.

CHAPTER XXVII.

TRAUMATIC AFFECTIONS OF THE BLADDER.

WOUNDS OF THE BLADDER.

WOUNDS of the bladder, as distinguished from lacerations or ruptures, are all serious in nature, and are perhaps most common in military surgery ; in civil practice they usually follow falls upon some object, such as a spike, which either traverses the abdominal wall or the pelvic outlet. The bladder may be wounded in operations, such as excision of the rectum, or portions may be removed designedly, as in cases of malignant growth.

In all these cases there is an external wound and the diagnosis is clear, as urine escapes through it ; that which passes through the urethra is blood-stained.

TREATMENT.—The object of this is, firstly, repair of the damage to the bladder wall, and, secondly, provision for drainage so that urine shall not collect either in the peritoneal cavity or in the pre-vesical cellular tissue ; hence, the parts must always be well opened up and the wound in the bladder fully exposed. In wounds made accidentally or intentionally during the course of an operation the edges will be cleanly cut, and the obvious procedure is to suture them at once (see pp. 271 *et seq.*).

The second point is to prevent urinary infiltration. When the wound is through the portion covered by peritoneum, the urine collects in the peritoneal cavity ; and after this has been removed, and the rent in the bladder sutured as recommended below (see p. 273), there is no need for drainage, and the abdominal wall is closed in the usual manner. When however the wound involves the cellular tissue and a part of the bladder uncovered by peritoneum, the wound must be thoroughly opened up, large drainage tubes inserted, and the skin wound left almost entirely open so as to allow the freest possible escape for the discharges. Urine must already have infiltrated the cellular tissue to some extent in these cases ; and although the small amount that has entered the tissues will not do any great harm if the urine be aseptic and the wound be kept from infection, yet there is a risk of the most serious septic complications unless free drainage be provided.

The only point in the *after-treatment* requiring consideration is the question of leaving a catheter in the bladder. The great objection to this, when the urine is aseptic, is the risk of introducing sepsis. At the same time it is hardly safe to allow the subject of an extensive rupture of the bladder to pass water spontaneously for the first few days, because the stitches are pulled upon every time the bladder contracts, and the union may give way. On the whole it is well to tie in a catheter for a few days, especially when the wound is through the portion of the viscus uncovered by peritoneum.

RUPTURE OF THE BLADDER.

Here the organ is injured without a skin wound, and the accident is a common complication of a fractured pelvis. In these cases the urethra is generally extensively torn also; the laceration may extend from it into the neck of the bladder or a sharp fragment of the pelvis may be depressed and cause a large lacerated wound. Another not uncommon injury is rupture of the vesical wall without any perforation from without. This can only occur when the bladder is moderately distended, and usually takes place in elderly subjects with large prostates as a result of a blow upon the anterior surface of the abdomen. It may also occur as a result of violent compression of the abdomen not necessarily fracturing the pelvis, and it is said to occur spontaneously as a result of a violent strain in people with atrophied and distended bladders.

The rupture may be either extra- or intra-peritoneal, or both, and is a grave injury as in many cases the urine is not aseptic.

SYMPTOMS.—In the first group of cases there will be a combination of symptoms due to the injury producing the rupture with those special to the injury of the bladder itself. In the second group the latter symptoms alone are present. In all cases there will be great shock, and there is a constant desire to micturate, which may or may not be effectual, according to the size and situation of the rent in the bladder. If the patient can micturate, as may be the case when the rent is small, and especially when it is extra-peritoneal, the urine will be blood-stained. When however there is an extensive intra-peritoneal rupture, all the urine will escape through it, and none through the urethra. When the injury to the bladder is an extension from one in the urethra there will be symptoms of ruptured urethra (see Chap. XXXVII.) in addition, and it may be rather difficult to diagnose that a laceration of the bladder exists as well; this however is a most important point, as the injury to the bladder requires immediate treatment. The diagnosis will be confirmed by signs of urinary extravasation into the pre-vesical cellular tissue in cases of extra-peritoneal rupture, or into the peritoneal cavity when the rupture is intra-peritoneal. In extra-peritoneal cases there will be a tender boggy swelling, dull on percussion, extending up behind the pubes, and accompanied, in a short time, by all the signs of extravasation of urine. When the rupture is intra-peritoneal however, there will be signs of

serious peritoneal irritation and evidence of a collection of fluid at the most dependent parts of the peritoneal cavity, followed soon afterwards by steadily increasing peritonitis.

The diagnosis is finally made by examining the interior of the bladder with an instrument. This is always a dangerous proceeding on account of the risk of introducing septic material, and therefore it should not be undertaken until the surgeon is prepared to proceed to any operative measures that may be necessary if the suspicion of a ruptured bladder be verified. It is well to use a metal instrument previously boiled, and it should preferably be a short-beaked catheter (No. 10 English), so that urine present in the bladder can be drawn off through it. The greatest care must be taken to avoid the introduction of septic material. The urethral orifice should be carefully mopped out with 1-40 carbolic solution, and subsequently with 1-2000 sublimate lotion. A urethral tube with a backward flow (see Fig. 62) should also be introduced about three inches down the urethra, and the terminal portion washed freely out with the same solution. If the rupture of the bladder be associated with laceration of the urethra, the passage of an instrument may be difficult, and the treatment of the case will then have to be conducted upon lines similar to those for ruptured urethra (see Chap. XXXVII.).

When the catheter has reached the interior of the bladder, the rent is usually easily felt, the point of the catheter passing through it either freely into the peritoneal cavity, whence it may draw off blood-stained urine from Douglas's pouch, or into the cellular tissue beneath the anterior abdominal wall. The freedom with which the point of the instrument can be moved about will give some indication as to whether the laceration is extra- or intra-peritoneal, as will also the distance to which the instrument can be passed. In the intra-peritoneal rupture the point can be made to move all over the abdominal cavity, and the instrument can be passed right up to its hilt without experiencing any resistance.

Should there still be any doubt in the surgeon's mind, very useful confirmatory evidence can be obtained by injecting fluid into the bladder and seeing how much returns. All the urine in the bladder is first drawn off and a measured quantity, say six ounces, of warm boracic lotion is rapidly injected and then allowed to return into a measure. If there be a rupture of the bladder, the amount returned will be considerably less than that injected. Such a procedure should not be adopted however unless the patient is actually on the operating table and ready for operation.

TREATMENT.—In all cases the rent in the bladder must be exposed, and the best plan is to expose its anterior wall as in supra-pubic cystotomy (see p. 289) before opening the peritoneum; no previous washing out or distension of the organ should be practised however. If the rupture turn out to be extra-peritoneal there will be extravasation of blood and urine in the pre-vesical space, and the further procedure will depend upon the conditions found. Thus, a depressed fragment of bone may require removal, and this may have produced a small rent in the bladder which can be closed by

a few sutures introduced by Lembert's method; or there may be a ragged opening extending in several directions, and possibly into the peritoneal cavity. If the opening be very irregular and contused and the urine be septic, or if the case be not seen immediately after the accident, it is well not to suture it, but to drain the bladder above the pubes (see p. 291). Under ordinary circumstances however, if the case be seen early, if the urine be aseptic, and if there be only a moderately lacerated wound, there is no objection to sewing up the rent as

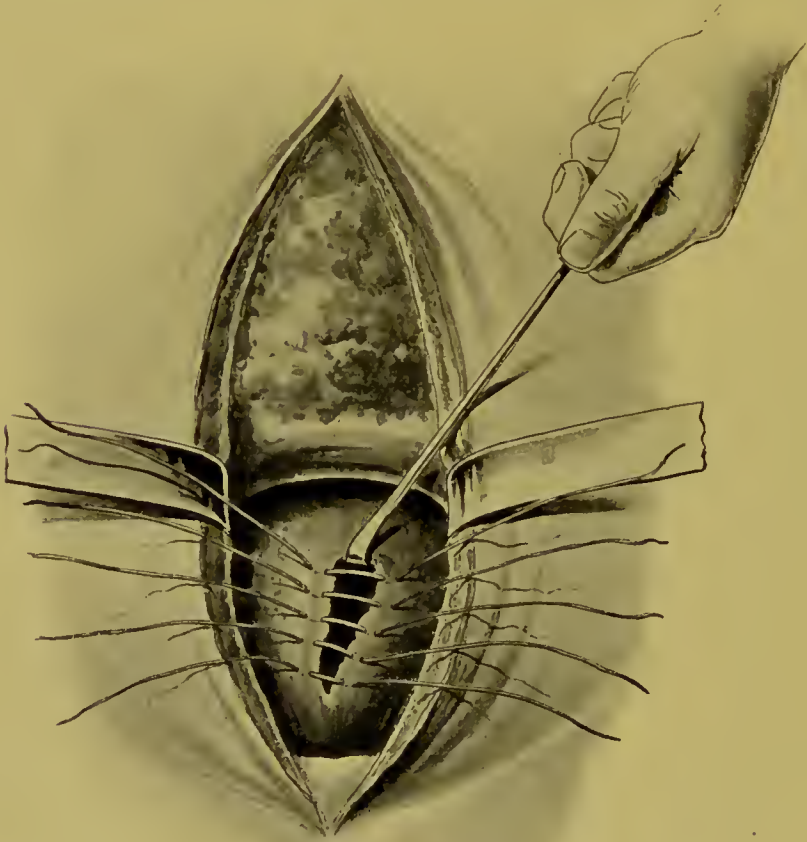


FIG. 60.—METHOD OF SUTURING AN EXTRA-PERITONEAL RUPTURE OF THE BLADDER. The laceration is rendered accessible by pulling up the upper extremity with a retractor, and interrupted sutures taking up the muscular coat only are inserted according to Lembert's plan. The peritoneal reflection is seen above the bladder. If preferred the suture may be continuous.

accurately as possible (see Fig. 60). The most important point is to provide for the free escape of urine and blood, from the very important pre-vesical space, and therefore, whatever be done to the wound in the bladder, the greatest care should always be taken both to disinfect the pre-vesical area at the time of operation, and also to provide for the escape of discharges from it afterwards by means of large drainage tubes; otherwise septic cellulitis of a grave type will follow the extravasation of urine into it.

If the rent be partly extra- and partly intra-peritoneal, the repair of the intra-peritoneal portion should be undertaken first (see Fig. 61), after which

the peritoneal cavity should be shut off entirely and the extra-peritoneal part of the wound dealt with (*vide supra*). As soon as the clots and extravasated urine have been removed, and it is seen that the rent runs into the peritoneal cavity, the peritoneal reflection above the bladder should be opened by a median vertical incision, and the steps detailed below for an intra-peritoneal rupture should be adopted. It must never be forgotten that an operation upon



FIG. 61. —EXPOSURE OF A RUPTURE OF THE BLADDER EXTENDING THROUGH THE PERITONEAL COAT. The peritoneal reflection is incised in the middle line and the intestines are packed off. This gives easy access to the intra-peritoneal rent which is closed first by Lembert's sutures. When this has been done, the peritoneal reflection is also sutured completely and the rest of the operation is done as shown in the preceding figure.

a case of laceration of the bladder associated with a fracture of the pelvis converts the fracture into a compound one, and that the question of sepsis is of the highest importance.

Should the rupture be purely intra-peritoneal, the tissues in front of the bladder are normal and the incision in the abdominal wall should then be extended upwards so as to open the peritoneum above the bladder: the posterior surface of the organ can then be inspected. The patient should lie flat upon the operating table until the abdomen has been opened, the

rent found and temporarily covered by a flat sponge or abdominal cloth and all the urine present in Douglas's pouch rapidly mopped out. Then the Trendelenburg position is substituted, the rent in the bladder being still closed by a sponge in order to prevent urine running into the upper part of the abdomen; the intestines are packed off by abdominal cloths, the bladder is pulled well forwards and the seat of rupture is exposed. This is usually a clean tear and is readily closed by a double row of Lembert's sutures, the first being interrupted and passing through the serous and the whole thickness of the muscular coat avoiding the mucous membrane, whilst the outer layer is continuous and takes up the serous membrane only. When this has been done, the field of operation is carefully cleaned, the cloths are removed, the pelvic cavity is flushed out with normal saline solution and the abdominal wound is closed without a drainage tube.

After-treatment.—The important question is whether the patient should be allowed to micturate naturally or whether a catheter should be tied in the bladder. The objection to a catheter is the risk of irritation and the passage of sepsis along it; on the other hand, there is a possibility of leakage under the strain of passing water, and undoubtedly the variation in size of the bladder as it becomes distended and empties itself must necessarily tend to loosen the stitches. Instead of tying in a catheter, some surgeons pass one at regular intervals for the first two or three days and draw off the urine. There does not seem to be much to choose between the two methods and we ourselves usually tie in a soft red-rubber catheter for the first three days, after which we draw off the urine at intervals whenever the bladder is getting distended. After the first week the patient micturates spontaneously. In extra-peritoneal ruptures also it is well if possible to tie a catheter in for the same length of time although, owing to the pre-vesical space being drained, there is not the same risk should leakage occur.

During the first ten days it is well to administer internal urinary antiseptics, such as boracic acid (gr. x.), salol (gr. x.), or urotropine (gr. v.), thrice daily so as to keep the urine as aseptic as possible, and the patient should not be allowed to stand for at least three weeks after the operation, as otherwise bulging of the scar may occur, especially when a drainage tube has been inserted into the pre-vesical space; he should wear a well-fitting abdominal belt for at least six months afterwards.

VESICAL FISTULA.

A fistulous opening leading to the bladder may occur in various situations. Thus, after supra-pubic cystotomy a fistula may occur in the supra-pubic region; severe pressure upon the bladder during parturition may be followed by sloughing and a fistulous communication between it and the vagina; similarly a communication may occur between the bladder and the bowel either from the bursting of an abscess into both structures, as may happen in appendicitis, or a direct communication may be established from tuberculous

or malignant disease of either organ; communication between the bladder and the rectum in the later stages of inoperable cancer of the rectum is fairly common; tuberculous disease of the prostate may give rise to an abscess which opens into the rectum, the prostatic urethra and the base of the bladder; fistulæ may also follow perforating wounds of the bladder.

When the fistula discharges externally, the diagnosis is readily made by observing the escape of urine; if the urine comes from the bladder, the escape is continuous, whereas if from the urethra it only escapes during micturition. Recto-vesical or vesico-vaginal fistulæ are also easily diagnosed; in both the orifice of communication can be inspected through a speculum. When however the fistula occurs between the bladder and some part of the intestine higher up than the rectum, the diagnosis is not always quite easy. When there is a communication with the small intestine, gas and fæcal material will be found in the bladder in comparatively large quantities. The presence of gas in the bladder is not pathognomonic of a vesico-intestinal fistula except when the patient passes large quantities and does so continuously. Fæcal material is always present at some time or other, and microscopical examination will detect its presence. A further test is to give by the mouth substances, such as charcoal, which undergo little change in the intestine; their presence will be detected in the urine some time afterwards. An examination of the fæcal material in the urine may throw some light upon the portion of the bowel involved in the fistula; the contents of the small intestine are fluid, partially digested and contain much bile pigment, while material from the large intestine is in fully digested lumps and gives no bile pigment reaction.

TREATMENT.—This will be largely determined by the situation of the fistula and the nature of the affection to which it is due.

Of vesico-intestinal fistula.—The communication between the bowel and the bladder should be cut off if possible, as otherwise fatal ascending pyelitis and pyelonephritis are very apt to set in. When the fistula is due to extensive malignant disease however, the question of shutting off the communication will be determined largely by the distress it entails. Unless the patient suffers serious inconvenience, it is hardly worth while to submit him to a somewhat severe operation when life cannot be prolonged for any length of time, more especially as it merely substitutes an artificial anus on the skin for the vesical communication. However, should be deemed advisable, as it may be in cases where the fistula is due to malignant disease of the rectum, a left inguinal colotomy with complete division of the bowel will considerably relieve the symptoms, although, since the communication is due to growth, a certain amount of discharge will still find its way into the bladder.

Should the fistula be due to a communication between the appendix or an appendix abscess and the bladder, it may be possible to do a laparotomy, detach the appendix completely, and then to invert and suture the opening into the bladder. This will give rise to a cure unless there be advanced renal mischief.

When the fistula is non-malignant in origin, and is situated in the small intestine, the ideal operation is to excise the affected loop of bowel, doing an end-to-end union, and then to detach the excised portion from the bladder, the opening in which is inverted and sewn up. This is of course a very severe operation, and can only be done when the conditions are particularly suitable; in cases for instance where the mischief is not due to tuberculous peritonitis, and also where there are no signs of advanced renal mischief.

Of vesico-vaginal fistula.—The communication may be either low down on the anterior wall of the vagina or it may be high up almost in the cervical region. The proper treatment is to pare the edges of the fistula, and then to close it with sutures. The most suitable position for this operation is the knee-elbow, which allows the anterior vaginal wall to fall down and come readily into view when the posterior wall is pulled well up. A good light and efficient sponging are essential. The actual steps of the various forms of plastic operations for this condition belong strictly to the department of gynaecology, and special text-books on the subject should therefore be consulted, at any rate for the more complicated cases. In a simple small fistulous opening on the anterior wall that is easily within reach, the principle of the operation is to pare the edges of the orifice completely as for a cleft palate, and then, separating the mucous membrane of the vagina for some little distance all round, the aperture into the bladder is firmly sutured by interrupted catgut sutures taking up the wall of the bladder just external to the mucous membrane, and outside this, a second row of silkworm-gut stitches uniting the cut edges of the vaginal mucous membrane. There may be considerable difficulty in the operation owing to extensive cicatrisation, especially when the fistula has followed sloughing after parturition, and it may be necessary before proceeding to operate to dilate the vagina by the introduction of large-sized bougies until the parts are sufficiently stretched to enable the fistula to be got at easily. Another point of great importance is to avoid injury to the ureters which are likely to be close to the field of operation. Their position should therefore be carefully examined, and if there be much cicatrisation it may be necessary to use a Kelly's tube (see p. 262), and introduce a ureteral sound on each side in order to render them evident. After the operation, the vagina is packed with gauze, and a catheter is kept in the bladder for a few days. The gauze plug may be taken out at the end of 24 hours, and the vagina frequently irrigated with a 1-4000 sublimate solution.

FOREIGN BODIES IN THE BLADDER.

A great variety of objects, such as lead pencils, hairpins, portions of catheter, etc., have been met with in the bladder and, quite apart from their size or from their liability to penetrate the bladder walls, their mere presence gives rise to irritation, and they soon become encrusted with phosphates, so that the patient becomes the subject of vesical calculus.

Symptoms.—The symptoms to which they give rise are mainly those of cystitis (see Chap. XXVIII.), and later on of stone (see Chap. XXXI.). The diagnosis is easily made if the true history can be obtained; failing that, inspection by the cystoscope in the male or the endoscope in the female will display the foreign body, and its nature can readily be recognised if seen before it becomes encrusted. Should it have become the nucleus of a stone, its peculiar shape will often lead to a suspicion of its true nature.

Treatment.—A foreign body in the bladder should be removed as soon as possible, and its removal is comparatively easy in the female, in whom it is perhaps more common than in the male, and in whom the urethra may be dilated, and the body removed by suitable forceps; it will hardly ever be large enough to require any cutting operation. In the male however the case is different. In certain cases, *e.g.* when a piece of catheter is in the bladder, a lithotrite may be used, and it may be necessary to break up the foreign body with it before it can be extracted safely; if the body be quite small it may be washed into the eye of a large evacuating catheter.

When the body is sharp-pointed, or when its removal by a lithotrite is likely to damage the bladder, the safest way is to do a median perineal cystotomy, to feel the foreign body with the finger and remove it with suitable forceps; this is better than a supra-pubic opening as the wound heals more rapidly. Should the body be too large for extraction in this manner however, a supra-pubic cystotomy must be performed, and this will be the operation of choice if one be required in the female. These operations are described elsewhere (see Chap. XXXI.).

CHAPTER XXVIII.

CYSTITIS.

CYSTITIS may be primary or secondary to inflammatory conditions of other structures in the immediate vicinity of the bladder; it may also be acute or chronic. It is most common in adult and advanced life, and is very rare in young subjects. The explanation of this fact is that the various diseases so often complicated by cystitis only occur in adult life.

All forms of true cystitis are due to bacterial infection, and in some this is the sole cause, while in others the disease is strongly predisposed to by other conditions such as stricture or enlarged prostate. The organisms producing it gain access from without, and most frequently find their way along the urethra, one of the commonest sources being the passage of instruments either to treat other conditions, such as stricture, in which case the cystitis is secondary, or to examine the bladder or draw off urine, in which case the disease is primary. The organisms may also reach the bladder from the urethra spontaneously, as in gonorrhœa, or they may possibly pass up the urethra, in cases of retention with overflow, while sometimes they find their way from the kidney when the affection is secondary to pyelitis or pyelonephritis, and possibly also sometimes from the blood in acute fevers such as typhoid.

We may divide cystitis into three large groups. 1. Those in which some pre-existing condition predisposes the bladder to infection. Here the cystitis is secondary and its treatment must be considered in connection with the primary condition; examples of this are found in strictures of the urethra enlargement of the prostate, vesical calculus, etc.

2. Those in which the bladder affection is part of a microbic disease, such as gonorrhœa or tuberculosis. These will be discussed in connection with those diseases.

3. Those in which the cystitis is the essential condition and may be looked upon as a primary disease. Here, however, there are also generally some previous conditions which favour the development of the organisms, chiefly

those interfering with the proper evacuation of the bladder or the nutrition of its walls. A typical example of this condition is paraplegia.

A great variety of organisms are found associated with cystitis, amongst the commonest of which are the various forms of cocci which decompose urea and give rise to ammoniacal urine. Of these the most common are said to be the diplococcus ureæ candidus, diplococcus urcæ liquefaciens or the bacillus liquefaciens. Another common organism found in cystitis is the bacillus coli communis, whilst in others the ordinary pyogenic organisms are present, and in typhoid fever the typhoid bacillus.

ACUTE CYSTITIS.

This may be either a superficial catarrhal inflammation affecting the mucous membrane only, or it may be a deeply-seated interstitial affection. In the acute catarrhal form, the mucous membrane is injected and there are numerous ecchymoses. Superficial ulceration may also occur if the disease lasts for any length of time. When the affection has penetrated deeply, the muscular and submucous coats become thickened and lose their elasticity and in rare cases abscesses may form and burst into the bladder. This leads to shrinkage of the organ so that it is no longer dilatable, and the bladder may even become adherent to other structures. A rarer form is that known as "membranous" or "diphtheritic cystitis" in which there is violent inflammation of the bladder wall followed by necrosis of the mucous membrane with extensive membranous deposits on the surface which peel off and are discharged as more or less complete casts of the bladder.

SYMPTOMS.—In acute cystitis the first symptoms are increased frequency and urgency of micturition so that the patient is compelled to evacuate the bladder immediately the desire arises. There is also pain, most marked at the end of the act as the bladder contracts to expel the last few drops of urine, and there is pus in the urine. There may be vesical tenesmus and spasm of the urethra, or the bladder may be so irritable that it is constantly contracting, and the patient suffers from a condition closely resembling incontinence. There is generally a sensation of weight in the perineum and tenderness in the hypogastric area. The urine is turbid from the presence of pus and may be ammoniacal; if it be alkaline, the pus becomes thick, ropy and tenacious. There may be blood in the urine, but it is usually present in such small quantities as only to be demonstrable by the microscope. There is loss of appetite, sleeplessness and a moderate degree of fever.

In membranous or diphtheritic cystitis, the severity of these symptoms is extreme. The pain is generally widespread and radiates into the loins, thighs and abdomen, whilst the urine contains large quantities of muco-pus and is strongly ammoniacal and sometimes very foul, whilst in bad cases much blood is present. When gangrene of the bladder wall occurs, the urine is almost faecal in odour, brown in colour, and contains shreds of necrosed mucous membrane. The temperature in bad cases may range from 102° to 104° F.,

and there is anorexia, sleeplessness and low muttering delirium, which ultimately terminates in suppression of urine, coma, and death.

In the third group, which may be termed the sub-acute cases, the symptoms are much less marked. The typical form is that due to gonorrhœa and slight cases of stone or those due to stricture of the urethra. Here the frequency of micturition is much less marked. There is pain at the end of the penis during micturition, with a certain amount of tenderness or uneasiness over the pubes or in the perineum, whilst the urine contains some pus and a large amount of mucus.

The *prognosis* depends largely upon the cause. When the disease is secondary to some obstruction to the outflow of urine, it usually subsides readily when the cause of obstruction or irritation is removed, provided that the mischief has not lasted long enough to cause serious changes in the kidney. Cystitis occurring in connection with puerperal or typhoid fever however is a very grave disease.

Various *complications* may arise during the progress of the affection. Amongst the most common is ulceration of the mucous membrane, which is often due to direct injury to the bladder wall from the use of instruments, but which may also be due to sloughing from the severity of the inflammation, as in typhoid or puerperal fever. The ulcers rarely go on to actual perforation of the bladder wall, but they may lead to considerable peri-vesical inflammation which manifests itself by pyrexia, often with rigors, and a gradually increasing area of dulness above the pubes, which gradually softens and suppurates, sinuses subsequently following. In the severest forms gangrene of the mucous membrane occurs, and this is practically always followed by death. Another serious complication met with more often in the chronic forms of the disease is ascending pyelonephritis from direct extension of the inflammatory mischief to the ureters and the pelvis of the kidney; when this condition becomes established the outlook is unfavourable, as it is very rebellious to treatment (see p. 207).

TREATMENT.—When the affection is secondary, the removal of the cause is always the first point of importance. In the cases however of which we are now speaking there is no definite primary cause to remove, and the treatment is directed to the relief of the inflammation itself.

Prophylaxis.—In connection with cystitis it must always be remembered that the disease is frequently set up by introducing septic material into the bladder, and therefore any case requiring instruments either for examination or treatment must be handled with great care. The precautions that should be taken before introducing instruments are referred to in detail in connection with enlargement of the prostate (see p. 336).

When acute cystitis is established.—The objects of the treatment are first to give rest to the bladder, and secondly to render the urine bland and unirritating, and to make the bladder and its contents as unfavourable a soil for the growth of bacteria as possible. In all except the gravest forms of acute cystitis the treatment is mainly medicinal and general.

In order to give rest to the bladder, the patient should be kept in bed with the pelvis raised and the knees drawn up so as to relax the abdominal muscles and diminish the pressure on the bladder. Raising the pelvis causes the intestines to gravitate upwards, and so further relieves pressure. The bowels must be freely opened so as to diminish congestion, and the patient will experience great relief from hot applications, the best of which are hip baths, as hot as can be borne, several times a day; immediately after the bath the patient should be put back to bed between blankets. In the intervals hot fomentations should be applied above the pubes and to the perineum, and in bad cases the rectum may be frequently irrigated with hot water. The distressing tenesmus is best relieved by opium, but the state of the kidneys must be carefully examined before giving it, and the drug should be withheld if the amount of albumen be out of proportion to the amount of pus in the urine, or if there be any other sign of renal disease. If the pain be very severe, injections of morphine may be necessary, but in most cases half-grain suppositories or an enema containing thirty drops of laudanum in two ounces of starch are more valuable. When the tenesmus is excessive, a catheter may be passed into the prostatic urethra, and fifteen drops of a 2 per cent. solution of eucaine instilled.

In order to render the urine unirritating, the first essential is to dilute it freely, and for this purpose large quantities of diluent drinks should be given. Infusion of linseed, decoction of triticum repens, barley water, or toast and water may be used, and the diet in the early stage should be entirely milk. Subsequently fish, milk puddings, and white meats may be allowed, but spiced dishes and the red meats should be avoided altogether. When the urine is strongly acid, as it often is in the early stages of acute cystitis; alkalies such as bi-carbonate of soda (20 grains), or liquor potassæ (10 minims), may be given frequently. Urinary antiseptics, such as boracic acid, salol, or urotropine in ten-grain doses are also of value, especially when the urine is foul, and particularly when the more acute condition is beginning to pass off. Quinine may be given internally in doses of three grains three times a day with advantage.

As regards local treatment, no irrigation is required or desirable in the ordinary cases of acute cystitis, but it may become necessary when much decomposing pus is present, and drainage through a catheter tied in the bladder may be called for if the bladder be not too sensitive.

If irrigation be necessary, the best way is to employ a syringe, as in order to get rid of the pus it is important to distend the bladder somewhat so as to dislodge the pus from the vesical folds, and this cannot be done efficiently by syphoning; a double-way catheter should not be used, as the fluid merely flows out directly it is injected, and does not really cleanse the bladder. As much distension should be effected as the patient can bear, and the forcible ejection of the fluid through the catheter will carry away the pus satisfactorily. Irrigation performed in this manner often arrests the decomposition very satisfactorily. The fluid used should be normal saline solution or boracic

lotion at the body temperature. Strong antiseptics or astringents should be avoided in the acute stages.

In membranous or gangrenous cystitis the bladder is practically a foul abscess cavity into which urine flows, and nothing short of perfect drainage will give the patient a chance. Catheterisation, or irrigation of the bladder, will not meet the requirements of the case, and the bladder must be opened either above the pubes or from the perineum. Probably a median perineal section (see p. 309) is the best method. A large drainage tube should be inserted through it into the bladder, and to the end of this is attached a small piece of glass tubing, so that the flow of urine can be inspected, and from the end of this a long india-rubber tube is carried into a basin containing 1-2000 sublimate solution, so that the urine is carried off as fast as it is secreted. The perineal wound is packed around the tube with iodoformed gauze, and an antiseptic dressing is applied outside. If the patient can bear it, the bladder should be irrigated from time to time, and this is easily done by attaching a funnel to the end of the tubing and syphoning warm salt solution or boracic lotion in and out of the bladder. It is essential not to introduce any air into the bladder, and therefore in the first instance the tube and funnel should be filled with fluid before being attached to the glass tube, and during attachment should be held well below the level of the pelvis. It is then raised slightly above the level of the pelvis, never however more than a foot, so that the fluid runs in very gradually. As soon as the patient experiences discomfort, or a desire to evacuate the bladder, the funnel should be lowered and the fluid allowed to escape. As a rule the organ is so sensitive that it will not bear much distension, and only an ounce or two can be run in at a time. Strong antiseptics should be avoided, as there can be no hope of carrying out anything like proper disinfection by their means. The tube may occasionally become blocked with shreds of membrane, which may require to be pulled out with a pair of forceps. Perineal is probably better than supra-pubic drainage, partly because the evacuation is more complete, and partly because of the danger of infiltration of the pre-vesical cellular tissue with the putrid urine. The tube and tubing should be changed daily, and the fresh tubes employed should be boiled before use.

The patient's general condition is so bad that stimulants are usually required, especially when the pulse is soft and rapid, and there is great restlessness and muttering delirium. An ounce of brandy or whisky should be given every three or four hours in these cases, together with two or three grains of quinine every three hours, either in milk or in combination with dilute sulphuric acid. In these cases opium must be very cautiously employed, and bromide of potassium (30 grains), with 10 grains of hydrate of chloral, should be employed in preference. If these fail however opium must be resorted to.

When the disease becomes sub-acute and the affection has almost subsided, but there is still a considerable amount of mucus in the urine, drugs

such as turpentine (℥ x.), terebene (℥ x.), oil of sandal-wood (℥ xv.), or tincture of cantharides (℥ v.), all of which exert powerful control over the secretion from the bladder, may be employed, and, unless there be distinct alkalinity of the urine, alkalies are generally valuable. Should the inflammation fail to clear up entirely, some form of intra-vesical medication will be indicated. In the first instance warm boracic lotion may be employed, but, as the disease becomes more chronic, resorcin (5-10 per cent. solution) may be used every alternate day with benefit. One of the best injections is nitrate of silver ($\frac{1}{2}$ per cent. solution), half a drachm of which is thrown into the bladder and allowed to remain. Iodoform and glycerine emulsion (10 per cent.) has also been used. In obstinate gonorrhœal cystitis a solution of perchloride of mercury, beginning with a strength of 1-20,000, and gradually increasing it to 1-5000 is often of value.

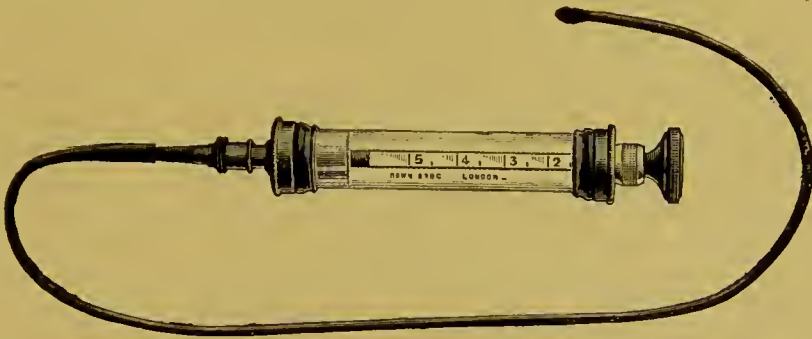


FIG. 62.—CATHETER WITH BACKWARD FLOW FOR IRRIGATION OF THE URETHRA AND BLADDER. The syringe attached to the catheter is only used when it is desired to instil a measured quantity of an astringent or irritant solution either into the bladder or the prostatic urethra.

In cystitis due to lesions of the spinal cord, the affection is rarely acute, and more often takes the chronic form. The essential in treatment is frequent irrigation of the bladder, which should be done through a catheter that has a backward flow (see Fig. 62). Irrigation should be begun directly the tube is introduced into the external meatus, and the instrument should be passed slowly down into the bladder so as to flush out the whole of the urethra from behind forwards, thereby diminishing the possibility of carrying septic material from it into the bladder; boracic lotion may be used in this way, while for irrigation of the bladder alone corrosive sublimate (1-20,000) or nitrate of silver ($\frac{1}{2}$ % sol.) may be employed. The irrigation should be carried out twice a day, and is best done with a funnel (see p. 282).

Should there be retention with overflow, a catheter must be tied in (see p. 345) so as to provide for continuous drainage of the bladder. Scrupulous care must always be taken with the aseptic management of the case. When there is true incontinence, no catheter is necessary, and the patient need only be provided with a suitable urinal, but the glans penis and the meatus should be frequently washed with 1-2000 sublimate solution. After each irrigation it is a useful plan to inject half an ounce of a solution containing

two ounces of glycerine, one ounce of bi-borate of soda and two ounces of water into the bladder, and leave it there. When there is a large quantity of viscid muco-pus which it is very difficult for the bladder to get rid of, the irrigation may be performed with a solution containing a quarter to half a grain of salicylic acid with two or three grains of bi-borate of soda to the ounce. The administration of urinary antiseptics (see p. 281) by the mouth is of great value.

CHRONIC CYSTITIS.

The causes of this affection are essentially those of the acute form although as a rule a cystitis does not become chronic unless there be some local cause requiring surgical treatment, and hence in the majority the treatment is mainly directed to such conditions as a stricture, enlarged prostate, stone, etc. Occasionally however ordinary acute attacks have a tendency to become chronic, and alternating attacks of acute and chronic cystitis are very likely to occur in patients suffering in this way.

Chronic cystitis takes the form of a chronic catarrh in which the mucous membrane becomes thickened, and the sub-mucous cellular tissue is also affected. There may be erosion of the surface of the mucous membrane with hypertrophy of the muscular bundles and the formation of a trabecular bladder in which the mucous membrane prolapses between the muscular bundles and forms sacculi. In some of these cases the bladder becomes enlarged and ultimately thinned, while in others its capacity diminishes and walls are much thickened.

SYMPTOMS.—These only differ in degree from those of the acute form. There is frequent painful micturition, with pus and mucus in the urine; the frequency as a rule is only slightly marked at night. The pain rarely amounts to more than a slight scalding on micturition and smarting at the tip of the penis. There may be some tenderness on pressure above the pubes and through the perineum or the rectum, but as a rule there is merely an uneasy feeling in the organ, especially when it becomes slightly distended. The urine contains most pus at the beginning and end of micturition, showing that the affection is chiefly confined to the trigone and neck of the bladder, and this is well seen if the patient be made to pass urine into three glasses; pus will be found in the first and last, but will be almost entirely absent in the intermediate portion.

The affection has to be distinguished from vesical tuberculosis and from vesical neuralgia of nervous origin such as occurs in locomotor ataxia. It also requires to be distinguished from suppurative pyelitis and pyelonephritis. In the last affection the frequency of micturition is as marked during the night as during the day, and the pus is intimately mixed with the whole of the urine. There is no scalding on micturition, and no tenderness on pressure over the neck of the bladder or when the organ becomes distended, whilst there is generally some tenderness or swelling in the region of the affected kidney together with some rise of temperature, and the cystoscope will

usually show pus issuing from the ureter on the affected side. The symptoms of vesical tuberculosis are detailed elsewhere (see Chap. XXIX.). When the case is of nervous origin the symptoms of the primary disease will make the diagnosis clear.

TREATMENT.—The first essential is of course the treatment of the primary condition; that of the cystitis itself is essentially local. The *general treatment* for acute cystitis (see p. 281) should be employed, and the administration of drugs acting directly upon the bladder, such as sandalwood oil, turpentine or cantharides is of distinct advantage. If the urine be ammoniacal, urinary antiseptics (see p. 281) are called for, whilst if it be acid, alkalies (see p. 281) are required; if it be alkaline but not ammoniacal, dilute nitro-hydrochloric acid may be administered, although it is doubtful whether the administration of an acid by the mouth has much effect upon the urine. The most reliance however must be placed upon the local treatment which will vary according to the severity of the affection.

Local treatment.—When the symptoms are very slight, irrigation of the bladder (see p. 281) with warm boracic lotion night and morning will usually suffice if the primary trouble has been removed. The urine is first withdrawn, and as much lotion as the bladder will tolerate is then injected with a syringe as rapidly as possible in order to distend the vesical mucous membrane. The washing-out should be repeated until the urine becomes quite clear, and it is well to leave about half an ounce of the lotion in the bladder at the end of the operation, to be expelled the next time the patient passes water. If the case does not yield to irrigation with boric acid, other substances, such as perchloride of mercury (see p. 283), may be used. When a strong solution is used, it is well not to leave any behind in the bladder, as it might cause irritation. When the neck of the bladder and the prostatic urethra are the portions most affected, as in gonorrhœal cystitis, the prostatic urethra should be washed out by a catheter with a backward flow after the irrigation of the bladder has been completed.

In rebellious cases, where the inflammation is mainly confined to the neck of the bladder, a useful plan is to instil five to ten minims of a 1-500 or 1-1000 solution of corrosive sublimate, or a $\frac{1}{2}$ to 2 per cent. solution of nitrate of silver into the prostatic portion of the urethra by means of a suitable graduated syringe (see Fig. 62) before washing out the organ. This is left *in situ* for five or ten minutes, and then the bladder is irrigated with boric lotion, and the strong solution is thus washed away. It is well to perform irrigation with the patient in the recumbent position, at any rate in the early stages. When he becomes accustomed to the operation, it may be done with advantage in the upright position, as the base of the bladder is thus more thoroughly emptied. If there be much muco-pus, the bladder may be irrigated with a weak solution of nitrate of silver, or one containing salicylic acid and bi-borate of soda (see p. 284), or the salicylic solution may be used first and the nitrate of silver employed afterwards. The latter is either allowed to escape entirely, or, in the more obstinate cases, half a drachm may

be left behind. The silver solution may be gradually increased in strength, and may with advantage be alternated with perchloride of mercury (1-1000 or 1-500).

When the scalding and frequency of micturition are excessive, the treatment will closely resemble that for the acute form of the disease (see p. 281), and it may even be necessary to employ continuous drainage. In the rare cases in which these methods fail, or when continuous urethral drainage cannot be borne, it may be necessary to open the bladder, and here it will undoubtedly be better to open the organ above the pubes (see p. 289), as there is not much danger of septic infiltration of the pre-vesical tissues, while at the same time the surgeon has the great advantage that he can inspect the interior of the bladder and may be able to treat some local condition that is keeping up the inflammation. Moreover, a perineal opening would be difficult to keep aseptic in these cases. The bladder is drained until the urine is free from mucus, pus, and organisms; this will generally be the case in about three weeks.

In the female, the treatment will be exactly similar to that in the male, except that, in the cases where continuous catheterisation fails to effect a cure, the urethra should be over-distended, and temporary incontinence of urine established. Should this fail, a supra-pubic operation must be undertaken, and there will then probably be found some local condition that can be remedied.

PERI-VESICAL INFLAMMATION.

This may follow extra-peritoneal rupture of the bladder due either to trauma or to perforation following grave cystitis. It may also arise in connection with inflammation of the seminal vesicles, the ureters, the pelvic bones or the Fallopian tubes.

The most common seat of peri-vesical inflammation is the space of Retzius, which is bounded in front by the pubes and the anterior layer of the transversalis fascia, behind by the anterior wall of the bladder with its covering derived from the posterior layer of the transversalis fascia, below by the capsule of the prostate and the pelvic fascia, whilst above it is limited by the approximation of the two layers of transversalis fascia. Purulent inflammation in this region may burrow up under the recti or may pass backwards to the rectum or to the iliac fossa on either side, and the prognosis is extremely grave.

The diagnosis is comparatively easy; there are symptoms of suppurative inflammation accompanied by a brawny, painful swelling immediately above the pubes, which subsequently fluctuates. The treatment should be that for any other form of suppuration,—free incision and drainage and, should it be found that rupture or perforation of the bladder has also occurred, suitable treatment must be adopted for that.

CHAPTER XXIX.

TUBERCULOSIS OF THE BLADDER.

THIS is not at all uncommon, although it is much less frequent than tuberculosis of the kidney. It may be primary or secondary, the former condition being so rare that its existence is doubted by some authorities. The secondary form may follow tuberculosis of the kidney, the prostate or elsewhere in the genito-urinary system. It may occur at any age, but it chiefly attacks young male adults and is predisposed to by any cause of cystitis, especially gonorrhœa. Its greater frequency in men is probably accounted for by the fact that in them the genital organs are not distinct from the urinary apparatus.

Tubercles are deposited in the superficial layers of the mucous membrane, and ulcers, varying in size from a pin's head up to a sixpence or larger, occur early. The mischief generally commences in the trigone and is most advanced there, but there may be numerous characteristic tuberculous ulcers scattered over a large extent of the vesical mucous membrane and the patient may even die of uræmic poisoning. The bladder wall becomes chronically inflamed and thickened and its capacity is much diminished. The ulcers are usually limited to the mucous and sub-mucous tissues; they may spread into the prostatic urethra and thence to the prostate itself.

SYMPTOMS.—The first and most important sign is an apparently causeless and painless frequency of micturition. At first the patient empties the bladder every two hours or so, but the intervals become shorter, until in bad cases the organ may have to be emptied every five or ten minutes, and a kind of false incontinence is established; this is particularly common in children. The frequency is as marked at night as during the day and the patient gets no rest. Micturition soon becomes painful, often unbearably so. The pain is worse at the commencement and end of the act and there is no scalding during it. Hæmorrhage is a common and early symptom; it generally occurs towards the end of micturition and is not influenced by rest; occasionally large quantities of blood are passed and the bladder may be filled with clots. Pus as a rule is small in quantity and mixed with

mucus; when a large amount is present it probably comes from the renal pelvis. Tubercle bacilli can sometimes be detected either alone or in conjunction with pyogenic organisms in the later stages. Should careful microscopical examination after centrifugalisation fail to detect the bacillus, its presence may be ascertained by cultivation or, still better, by injecting the urine into animals. There is often polyuria and the urine may be either acid or alkaline. The cystoscope is not of much value on account of the great irritability of the bladder, and it should only be employed just before proceeding to operative interference; by it the ulcers may be seen. The disease progresses slowly, often with marked variations, but in the end the patient dies worn out by sleeplessness, hæmorrhage and hectic fever or else from tuberculosis elsewhere.

The *diagnosis* as a rule is not difficult, especially in advanced cases or when there is tuberculous disease elsewhere. The insidious onset of the disease is an important point, and the diagnosis is confirmed if the bacillus be found in the urine or if ulcerations be seen with the cystoscope.

TREATMENT.—This will vary according to whether there is tuberculosis elsewhere. The outlook is much better should the disease be primary in the bladder or should there be no tuberculous mischief in the kidney or the prostate. Unfortunately we do not know of any method that will certainly bring about a cure in any case, although much may be done to relieve the patient's distress.

(a) **Medical.**—Medical treatment should be adopted in all cases. Perfect hygiene, nourishing diet and a residence in the country or at the seaside are of the first importance, and moderate exercise is also advisable. The acuter symptoms may be relieved by hot saline baths, stimulating applications to the hypogastrium and hot rectal enemata. Cod-liver oil should be given in large doses, and arsenic, creosote, opium or belladonna may be useful. These general methods may however be ineffectual, and local measures must then be employed; these take the form of topical applications to the bladder or more vigorous surgical procedures designed to give the bladder complete rest. It is well to try non-operative local measures first, as operation is by no means certainly curative and entails considerable discomfort, and therefore should not be resorted to except when the symptoms are severe and it is clear that milder measures will not yield satisfactory results.

The non-operative local treatment consists in irrigating the bladder and injecting various drugs designed either to relieve the pain or to inhibit the growth of the tubercle bacillus. For the relief of pain, weak eucaine solutions (2%) or preparations of opium are employed, but care must be taken with them because the bladder is ulcerated and its surface is therefore absorbent (see p. 257). On the whole, anodyne applications are better administered in the form of rectal suppositories. Much relief may be obtained by irrigating the bladder with hot boracic lotion (see p. 281): salicylic acid and nitrate of silver, which are useful in other forms of cystitis

are almost always harmful in these cases. The iodoform and glycerine emulsion has been much used, but is disappointing in its results; if employed it should be diluted three or four times with water before being injected. Iodoform pills (half to one grain) internally are perhaps more effectual than the local use of the emulsion. Our own experience is that irrigation with warm boracic lotion relieves the patient as much as anything. The use of 1-5000 sublimate solution has been advocated by some. The various urinary antiseptics (see p. 281) and sedative drugs, such as tincture of hyoscyamus and decoction of *triticum repens* are also useful; morphine may be required if there be much strangury. Attempts to increase the capacity of the bladder by gradually distending it with fluid are not promising.

(b) Operative.—This aims at giving complete rest to the bladder by opening the organ above the pubes. Even if this fails to cure, it relieves the patient immensely, as the repeated painful contractions of the bladder are avoided. Perineal drainage is objectionable because the tube lies in contact with the ulcerated portion of the bladder in a very sensitive painful area, while it is very difficult to prevent sepsis occurring in that situation. The supra-pubic operation has the further advantage that the interior of the bladder may be inspected and suitable local treatment applied to the ulcers.

Supra-pubic cystotomy.—The pubes is shaved and disinfected in the usual manner, and the patient lies upon the back with the pelvis well raised, so that he is almost in the Trendelenburg position. This is useful, as the intestines gravitate towards the diaphragm, and the peritoneal pouch is carried as much as possible out of harm's way. In order to expose the organ with the least damage to other structures, it is always well to render it as prominent as possible, and we are accustomed to do this by distending it with as much warm boracic lotion as it will conveniently hold.¹

Before the boracic lotion is left in the bladder, the organ is washed out thoroughly (see p. 281), and the patient should be fully under the anæsthetic so as to diminish irritability. The amount employed for distending the bladder will vary; a healthy organ will easily hold from eight to ten ounces, but a contracted one holds much less, and the distension should not be pushed beyond the point at which the patient commences to make expulsive efforts. The catheter is now withdrawn, and the urethra is occluded either by tying an indiarubber band around it or by an assistant's fingers. When the bladder is

¹ Some surgeons distend the bladder with air, on the ground that there is less risk of soiling the wound when the bladder is opened. This cannot be a matter of much importance as it is quite impossible to keep the wound free from infection during the subsequent manipulations. There is also a certain amount of risk in doing it because one cannot gauge the amount of air introduced in the same way as one can measure the amount of water, and to pump in air with a bicycle-pump might very readily lead to over-distension of the bladder. Therefore, if air be employed, the bladder should not be filled up until the abdominal wall has been opened. The incision above the pubes should be made, the muscles separated, the bladder wall felt, and then the organ may be gently distended with air. It must not be forgotten that distension of the bladder with air may result in the introduction of organisms which set up decomposition of urine.

not very distensible it is well to introduce a bulbous-ended metal sound in addition ; by depressing the handle of this, its point can be made to project beneath the abdominal wall just above the pubes, and the bladder wall can thus be easily defined. It was formerly the custom in all cases of supra-pubic cystotomy to employ an indiarubber bag to distend the rectum and still further push forward and make prominent the dilated bladder. This method is open to many objections however and has few if any advantages, and we therefore are not in the habit of employing it. In the cases under consideration however the use of the rectal bag may have a distinct advantage. It should be introduced into the rectum in the collapsed condition, and left thus during the earlier stages of the operation. Later on, when the bladder has been opened, distension of the bag with air pushes forward and steadies the base of the bladder and so renders the surgeon's subsequent manipulations much easier.

The patient's legs are allowed to hang down over the end of the table, and an incision three inches long is made from the centre of the symphysis upwards in the middle line. If this be kept strictly in the middle line, the interval between the pyramidal muscles is hit off, and the loose pre-vesical cellular tissue is seen ; if the interval between the muscles be not found, they may be directly incised. If the abdominal muscles be now strongly retracted, inspection of the pre-vesical tissues will generally show the line of the peritoneal reflection which can be seen to alter its level during respiration. The pre-vesical fat is then torn through with two pairs of forceps just above the symphysis, and the whole mass together with the reflection of the peritoneum is pushed well up into the upper angle of the wound.¹ This will expose the bladder wall, which is known at once by its peculiar striation and by the presence of large veins over it. A third retractor is now added to pull up the fat and peritoneal reflection, and a couple of sharp hooks or two stout silk threads are made to penetrate the whole thickness of the vesical wall, one on either side of the proposed line of incision.² The bladder is then incised vertically in the middle line between the two guides, or, if the surgeon has previously inserted a bougie, the tip of this may be made to project beneath the bladder wall so that it can be cut down upon directly. The knife should enter the bladder at the proposed lower limit of the incision and should cut upwards. Directly the bladder is opened, the wound becomes flooded with lotion and the bladder tends to collapse, but its retraction is prevented by the guiding stitches or hooks already inserted. The incision made should be large enough to insert two fingers in the first instance, and this may be increased later on if necessary.

¹ Special care should be taken not to burrow down in the pre-vesical cellular tissue behind the symphysis in the endeavour to get well below the peritoneal reflection, as this will leave a ragged cavity in which dangerous cellulitis may occur.

² The advantage of the silk threads over the hooks is that in the later stages of the operation they are very useful in pulling up and steadying the edges of the incision when it is desired to suture the bladder.

The edges of the incision in the bladder are now held well open by two or three suitable large retractors and the interior of the organ is mopped out and carefully inspected¹; if necessary the bag in the rectum is inflated so as to push up the base of the bladder. The object of the surgeon is to expose and treat every individual ulcer that may be present, and the mucous membrane must therefore be gone over most thoroughly. The great drawback to this is the constant secretion of urine through the ureters, so that the wound becomes rapidly moist even after the most careful sponging. A very useful aid is the "caisson" speculum (see Fig. 63) by which areas of the bladder can be isolated, dried and appropriately treated. In order to work through this, long-handled forceps, scissors and knives are necessary. Small ulcers may be picked up and snipped out bodily with a portion of the surrounding mucous membrane, any oozing point being stopped by temporary pressure or touched with the electric cautery. Larger ulcers cannot be dealt with in this way and they must be scraped, although this is difficult as it is impossible to get firm resistance to scrape against even by using a bag or an assistant's finger in the rectum; the surface of the ulcer may be afterwards touched with the cautery.² When every ulcer has been treated in turn, powdered iodoform is rubbed firmly into each and in addition the surface may be painted over with a saturated ethereal solution of the drug; this should not be used however if the ulcerated area be extensive, as sloughing might be caused.

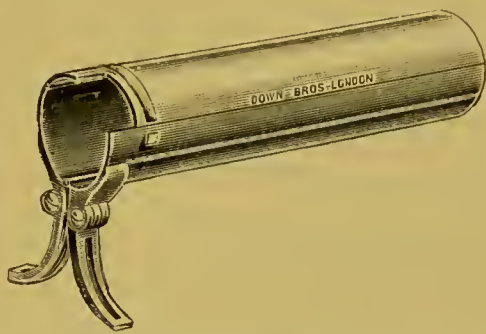


FIG. 63.—"CAISSON" SPECULUM FOR THE BLADDER. The instrument is here shown opened to its full extent. For facilitating introduction it is designed to fold up to a certain extent.

It now only remains to drain the bladder by a large tube projecting well into its cavity but not reaching the trigone, and furnished only with lateral holes where it is in the bladder. It should reach down to but not touch the internal meatus. The remainder of the incision into the bladder is then closely stitched up and a good plan is to insert one or two sutures between the edges of the portion of the bladder wall through which the tube passes and the abdominal muscles, so as to prevent the two structures being separated. A second small drainage tube is inserted into the pre-vesical space and the skin wound is closed by interrupted silkworm-gut sutures taking up the muscles as well as the skin.

After-treatment.—The foot of the bed is raised so as to take the pressure of the intestines off the bladder, whilst the bladder-tube is connected with a continuous drainage apparatus (see p. 282) and is left undisturbed for four or five days in order that a definite track may be established around it; it is

It is well to reflect the light from a powerful electric lamp with a forehead mirror.

² Deep ulcers however should not be touched with the cautery, as perforation may result.

then taken out and a fresh one introduced and changed daily to prevent the deposit of salts upon it.¹ The tube draining the pre-vesical space may be left out in three days if no suppuration occurs. The bladder should be washed out twice daily with boracic lotion through the supra-pubic tube, and a drachm of iodoform and glycerine emulsion (10%) afterwards introduced into the bladder. The drainage should be kept up until the pus has disappeared and there are no other signs of inflammation; this will take at least six weeks. The greatest care must be observed in the aseptic management of the case, and gauze should be carefully packed around the tube, and the skin thoroughly cleansed at each change of dressing. The pubes should be shaved from time to time and carefully disinfected, and the tube should be boiled each time before it is introduced into the bladder.

This plan of draining the bladder continuously after the local treatment of the ulcers answers fairly well and is a great improvement upon the method of suturing the organ completely after the ulcers have been treated. General medical measures must also be adopted (see p. 288).

The treatment of secondary bladder tuberculosis.—The surgeon will probably be wise to delay operative interference here as long as possible. If the patient suffers severely however, the only method likely to give relief is supra-pubic drainage; this obviously cannot be curative and probably will have to be permanent.

There will be fairly free leakage of urine from the abdominal wound, at any rate for the first few days, and large pads of sterilised compressed moss or other suitable material should be placed in each groin in order to soak it up. The dressings will need changing several times a day for the first few days.

CHAPTER XXX.

NERVOUS AFFECTIONS OF THE BLADDER.

NOCTURNAL ENURESIS, OR INCONTINENCE OF URINE IN CHILDHOOD.

THIS has nothing in common with incontinence of urine met with at other periods of life, and may be divided into several groups :

(a) **True nocturnal enuresis.**—In these cases there is perfect control over the bladder during the day, while enuresis occurs at night. The condition is probably always nervous in origin, and the act of micturition is purely reflex, being often caused by some psychical phenomenon such as a dream.

(b) **Nocturnal enuresis with imperfect control during the day.**—Here the patient is obliged to empty the bladder in the daytime immediately the desire is experienced. This condition may be due to several causes, the commonest of which is some peripheral irritation, such as phimosis, congenital narrowing of the urethra, vesical calculus or worms in the rectum.

(c) **Enuresis both by night and by day.**—The probable cause of this condition is inability of the sphincter vesicæ to resist the passage of urine directly the bladder begins to be distended. In extreme cases the sphincter is paralysed, and the urine dribbles away as fast as it is secreted, and there is therefore true incontinence ; as a result the bladder becomes permanently contracted and indistensible. This condition is not uncommonly met with as a result of a previous over-distension of the bladder, such as may occur during specific fevers.

Incontinence of urine associated with epileptiform convulsions is practically the only form of nocturnal enuresis likely to be met with in the adult male, and Trousseau remarks that all forms of nocturnal enuresis in adults are due to epilepsy ; micturition usually occurs at the end of the fit.

The prognosis in all these forms, except the last, is very good, for a cure is practically certain to result, though the affection may last a long time.

TREATMENT. — (a) **Of true nocturnal enuresis.**—There are three indications for treatment; firstly, to divert the patient's attention from the affection from which he suffers; secondly, to insure light sleep, so that the child may awake immediately the bladder becomes distended; and thirdly, to render the urethra so sensitive that the desire to micturate will at once waken the patient.

The child should be consequently encouraged to think that he will speedily grow out of this repulsive affection, and should not be punished for what is not his fault. He should sleep on a hard mattress, and be lightly covered, and a night-light should burn in the room. He should be taught to lie upon one side and, if there be any difficulty about this, some hard object may be strapped over the spine to prevent his sleeping on the back. Any obstruction to the air passages such as adenoids or enlarged tonsils should be removed, the amount of fluid taken at night should be restricted, and the bladder should be emptied the last thing before going to sleep. If the child be a heavy sleeper, a little tea or coffee may be given before he goes to bed, and he should always be instructed to pass water whenever he wakes. A good plan is to wake young children up three or four hours after they go to bed, in order to establish the habit of passing water. The diet should be plain, and highly nitrogenous food and anything found to increase the incontinence should be avoided.

The best drug is undoubtedly belladonna or atropine; $\frac{1}{120}$ th or $\frac{1}{100}$ th of a grain of atropine may be given to children from six to ten years old about tea time, and repeated at eight o'clock. The condition of the pupils should be noted; if they be dilated, the evening dose should be omitted. In all cases the urine should be examined, and any abnormality corrected. Amongst the methods of local treatment the galvanic current is useful. The negative pole is placed over the lower part of the spine, whilst the positive is applied to the perineum immediately behind the scrotum. A weak current (5 milliampères) is applied for about three-quarters of an hour daily. The Faradic current may be alternated with this, one pole being introduced into the rectum whilst the other is applied in turn to the perineum and the supra-pubic region. The child may resent the introduction of the pole into the rectum, in which case the galvanic current alone should be employed.

(b) **When there is incontinence both during the day and the night**, any cause of irritation must be removed in the first instance. The further treatment will be very similar to that recommended above, but the bladder must be examined to see whether any contraction has occurred, and, if so, the organ should be gradually distended by an increasing quantity of warm boracic lotion. At first a small quantity only can be introduced, but by persevering the amount will gradually increase and, as the bladder becomes dilated, the incontinence will diminish. A good deal of the incontinence during the day is due to excitement, and the child should therefore be guarded against this as much as possible.

(c) When the incontinence is due to paralysis of the bladder it is best treated by administering strychnine,¹ or other suitable spinal tonics internally combined with the application of electricity locally (*vide supra*). *Rhus aromatica* (℥ v-xv of the fluid extract) is also useful.

SPASM OF THE BLADDER.

SPASMODIC MICTURITION.—An uncontrollable impulse to pass urine is not uncommon in connection with extreme fright. It may also occur as the result of affections of the prostatic urethra following masturbation or gonorrhœa; abnormally acid or concentrated urine may produce the same effect. As a rule the spasm only occurs during the day, and this is a very characteristic symptom. The frequency of micturition varies much, and if a sound be passed, the prostatic urethra is found to be unduly sensitive, as may also be the urethra and bladder as a whole.

Treatment.—Mental excitement must be avoided in cases due to a central origin. In other cases the abandonment of sexual excess, combined with a sea-voyage or a long holiday in an interesting locality with plenty of physical exercise will cause the condition to disappear. The cure may be hastened by the administration of bromide of potassium followed by quinine and arsenic. The frequent passage of a sound or the irrigation of the prostatic urethra with hot boracic lotion may be useful if the case prove obstinate.

SPASMODIC RETENTION or **STAMMERING BLADDER.**—Here the affection is in the sphincter vesicæ rather than the walls of the bladder, and there is no undue frequency of micturition, but rather a difficulty in commencing the act which may be spasmodically interrupted when once begun. The mildest form is the difficulty experienced by many persons in micturating in the presence of others; in bad cases there may be marked retention. The condition is usually due to an abnormal condition of the prostatic urethra, and traumatism and gonorrhœa are the most frequent causes. It may be met with in connection with constipation and prolapse of the rectum.

When a sound is passed, considerable spasm is evoked. The best plan is to pass a large well-warmed instrument, and to keep up gentle pressure when the point is arrested, as this will gradually overcome the spasm and the instrument will slip into the bladder where it should be left for five or ten minutes at each sitting. This should be repeated daily so that the sphincter gradually becomes accustomed to relax, and the spasmodic condition passes off. Any existing lesion in the prostatic urethra should receive proper attention (see Chap. XXXIX.).

¹ The following prescription may be used :

℞	Liq. atropiæ sulphatis,	-	-	-	℥ v
	Liq. strych. hydrochl.,	-	-	-	℥ x
	Syrupi,	-	-	-	℥ xv
	Aquam ad.	-	-	-	℥ j

Five drops to be given before bedtime, and the dose increased until ℥ x are being taken.

PARALYSIS OF THE BLADDER.

This may vary much in degree and may affect either the bladder walls or the sphincter or both. In a slightly paralytic bladder when the sphincter is intact, the organ is incompletely emptied, the urine flows somewhat slowly and is passed much better in the erect position. There is nearly always some residual urine.

This condition may occur in connection with disease or injury of the brain or spinal cord, in connection with prostatic hypertrophy or from previous prolonged retention of urine, or it may be an accompaniment of old age. The patient, after taking a long time and a good deal of exertion to get the urine to flow, finds that it simply trickles out without any force, and there is always a sensation of having imperfectly emptied the organ, while micturition in the recumbent position is much more difficult or even impossible.

The existence of the condition is easily ascertained by passing a catheter immediately after the patient has passed his urine, when the existence of residual urine will be manifest. In these cases incontinence with overflow will follow if proper treatment be not adopted. When the sphincter is paralysed there will be true incontinence.

TREATMENT.—In the simpler cases massage to the supra-pubic region, douches to the perineum and the use of salt baths are of advantage. The patient should be instructed to empty his bladder as frequently as possible, and for this purpose slight diuretics may be administered; ergot is also a valuable drug, whilst electricity is often extremely useful. The continuous current is the better, but a Faradic current may be employed. One pole is introduced into the rectum or applied over the loin whilst the other is introduced into the bladder by a specially insulated sound. When the paralysis mainly affects the sphincter, the current should be applied directly to it by a special sound introduced into the prostatic urethra. The greatest care must be taken here in the disinfection of the instruments, as a cystitis once set up is likely to lead to fatal pyelitis or pyelonephritis. The catheter should be passed regularly at least once a day, or oftener in bad cases, so as to make sure that there is no retention. If there be any decomposition of the urine, the bladder must be washed out two or three times daily, and the ordinary urinary antiseptics administered (see p. 281).

CHAPTER XXXI.

VESICAL CALCULUS.

THE stones most often met with in the bladder are composed of uric acid or urate of soda ; after them in order of frequency come calculi of phosphate of lime or triple phosphates, whilst those of oxalate of lime are less frequent and those of cystine or xanthic oxide are rare. The calculus may be composed of one of these substances alone but, with the exception of the two last-named forms, it is generally a mixture of more than one. A stone that has remained long in a bladder in which there has been cystitis is generally covered with a phosphatic deposit.

Vesical calculi may be single or multiple and vary much in shape ; single stones are usually round or oval, multiple stones are often facettèd. Phosphatic stones are usually smooth, whilst an oxalate calculus is so rough that it has received the name of “mulberry calculus.” Uric acid calculi are brownish-red in colour ; uratic stones are of a duller sandy colour ; phosphatic stones are white ; mulberry calculi are of a dark claret colour.

Vesical calculi may either form *in situ* or, more commonly, they descend from the kidney and increase considerably in size while in the bladder from deposit of fresh salts upon them. Stones forming primarily in the bladder generally occur in connection with some obstruction to the outflow of urine, as for example in enlarged prostate, and there is usually a foreign body, such as blood-clot or a portion of catheter which acts as a nucleus upon which the stone is deposited.

The affection is more common in men than in women in whom no doubt small stones are much more easily passed and therefore escape notice. The causes are similar to those of renal calculus (see p. 222). A stone in the bladder usually lies in the neighbourhood of the trigone if it be of moderate size, and alters its position according to the movements of the patient. The position in which it is usually found is well down behind the prostate near the internal meatus. If the bladder be sacculated, it is not uncommon for the stone to find its way into one of the sacculi where it increases in size so that it becomes permanently encysted in it. Occasionally

the stone becomes arrested at the vesical orifice of the ureter on its journey from the kidney and may lie partly in the bladder, while in other cases the calculus may be adherent to the mucous membrane; this is especially the case when the latter has been ulcerated. Under somewhat similar circumstances there may be extensive encrustation of the surface of an ulcer or a growth with phosphates and all the symptoms of stone without the formation of a true calculus.

In the early stages there is no cystitis, but this may supervene as the affection progresses or after instrumentation; it increases the sufferings of the patient and facilitates the growth of the stone by the deposition of phosphates from alkaline decomposition of the urine.

SYMPTOMS.—The classical symptoms are pain, frequent micturition and hæmaturia. The *pain* occurs towards the end of the act of micturition as the bladder contracts upon the calculus and it is usually referred to the glans penis and may persist until enough urine has been secreted to separate the bladder wall from contact with the stone. Exercise also brings on attacks of pain which pass off under rest. It is characteristic that the pain entirely disappears in certain positions, such as the dorsal, so that it is absent at night.

Hæmaturia is a constant and important symptom, occurring quite early in the case and being profoundly influenced by movement. As a rule it occurs towards the end of the act of micturition, during the passage of the last few drops of urine, and is due to injury of the bladder wall by contact with the stone. The quantity of blood is slight compared with that in vesical growths.

Frequency of micturition varies very much; it depends largely on movement and on the presence of cystitis. There is often sudden interruption of the flow of urine accompanied by a sharp pain in the glans penis which is very characteristic of a small mobile stone suddenly rolled by the stream of urine against the orifice of the urethra.

A valuable point is a history of previous renal colic and this should always be carefully inquired for. There may possibly be a history of previous bladder troubles in cases where the stone has formed primarily in the bladder.

In the physical diagnosis of the stone palpation, sounding and cystoscopy may be employed. A large stone may be detected by bi-manual rectal or vaginal palpation, but this method is not of much value except in spare subjects, young children and females. It usually requires general anæsthesia and, when full relaxation is obtained, a fair-sized stone may then be felt between the two hands.

The bladder sound (see Fig. 54) is a most important instrument in the diagnosis, for by it the size, consistence, and number of the stones present may be approximately ascertained. When sounding the bladder it is advisable that the organ should contain at least two or three ounces of fluid, as in a collapsed bladder a small stone may easily become covered by the folds of

mucous membrane and escape notice. Moreover, if there be cystitis the examination is much more painful if the bladder be empty. It is, however, advisable not to use more than five ounces as, if the bladder be too distended, the beak of the sound will not be sure to reach the bladder wall in the post-prostatic region, and a small stone may thus escape detection.

If it be possible, the patient should be sounded for stone as an immediate preliminary to any surgical measure that may be necessary, as the risks of cystitis are considerably diminished if the whole matter be dealt with at one sitting. In any case the urine should be examined before it is decided to sound the patient, and, if it be foetid or ammoniacal, suitable treatment should be adopted to render it more healthy before the sounding is performed. The *sounding* should generally be done in the patient's own house, especially with elderly subjects, and it is well to confine him to bed for a few hours before and after it is done. During sounding the patient lies flat upon the back, and if he be elderly it is well to raise the pelvis so as to allow the stone to fall upwards away from the post-prostatic pouch. Full antiseptic precautions must be taken with regard to the disinfection of the sound, the orifice of the urethra, and the hands; these are dealt with fully later (see Chap. XXXVI.). It is well to employ a general anæsthetic, but this is not essential. A soft rubber catheter is passed, the urine is withdrawn, and three ounces of warm boracic lotion are thrown into the bladder. If there be much irritability of the organ and no general anæsthetic is being used, a small quantity of a 2% eucaine solution may be added to this. The sound is then passed in the usual way, and may strike the stone immediately it reaches the bladder. Should it not do so, a systematic exploration of the interior of the organ should be undertaken. The beak is directed first to one side, and the instrument is made to sweep along the base of the bladder from before backwards in this position, so that the whole of that side of the base of the organ is explored. The beak is then turned to the opposite side, and a similar procedure is gone through. The whole of the base of the bladder is thus explored, and the anterior surface may also be examined by depressing the handle and sweeping the beak first over one half of that portion and then over the other. Finally the beak is directed downwards, and the handle is well raised so as to explore the post-prostatic region. The position of the point of the instrument is always known by the mark affixed to the handle. Should the prostate be enlarged, a sound with a much bolder curve should be employed for the examination of the post-prostatic pouch, which may be rendered still more accessible by the introduction of a finger into the rectum, or, in very marked cases, by distension of the bowel with a rectal bag.

When the sound strikes the stone there is a characteristic sharp metallic ring, whilst a foreign body or a new growth gives rise to the sensation of something comparatively soft.

Many difficulties are met with in sounding. A stricture of the urethra may grip the shaft of the sound, and prevent its proper manipulation. The

stone may be so small as to escape detection among the various folds of the bladder. The simplest way of overcoming this difficulty is to introduce a Bigelow's evacuating tube and to connect it with the ordinary lithotripsy evacuating bottle; this will draw small stones either actually into the evacuator, or, if they be too big for this, they will strike the eye of the catheter with a characteristic metallic ring.

The most serious difficulty is when the stone is encysted, as there is only a small surface uncovered and, even if the sound should strike it once, it cannot necessarily be made to do so repeatedly. An encysted stone may always be suspected if the sound can only be made to strike it in one definite position, and when its beak cannot be made to pass around it. Another difficulty is the presence of phosphatic deposit in the bladder, and this has led more than once to an abortive operation for stone; the indefiniteness and immobility of the phosphatic mass should prevent a mistake of this kind.

A fairly good notion of the size of the stone may be gained by drawing the beak of the instrument over it from end to end, and then from side to side. Its consistence and structure can often be told by the characteristic sound on striking it, the sharp ring of the oxalate calculus differing widely from the dull sound given by the uratic stone, and both of these being quite unlike the soft grating of phosphatic concretions.

When a stone has been found and its size has been estimated, no further examination is necessary before proceeding to remove it. When however no stone is detected, or if a stone once felt cannot be detected again, the bladder should be examined with the cystoscope (see p. 259), which will frequently yield the necessary information. This instrument is of no great value in the diagnosis of stone, but when the calculus is encysted it is of great importance.

The *complications* of stone are not very numerous. Amongst the most important is cystitis with its sequelæ, ascending pyelitis and pyelonephritis. A stone seldom remains long in the bladder without setting up cystitis, and this may be of a severe septic nature, wearing the patient out, and eventually causing death from surgical kidney. Stone in the bladder is a common cause of prolapse of the rectum or hæmorrhoids, due to the straining in passing water.

TREATMENT.—As the calculus is a foreign body, the only possible treatment is to remove it by surgical means. In former times and even at the present day attempts have been made to dissolve the stone either by drugs administered internally or by injections into the bladder. These attempts are quite futile. There is no doubt that a patient is often relieved by a stay at mineral springs such as those of Vichy, Carlsbad or Contrexéville, but the explanation of this is not that the waters exert any true solvent action upon an already formed stone. Symptoms similar to those of stone are frequently due to the passage of highly concentrated urine or small crystals and this condition may be improved by a cure at one of the foregoing health resorts. Even when a stone is present, a certain amount of relief is obtained, probably by the beneficial effect of the waters upon the cystitis present.

Some authorities recommend the injection of solvents into the bladder in these cases, but the only condition in which this method is at all useful is when there is a large phosphatic incrustation which cannot otherwise be detached; the frequently repeated injection of a weak solution of hydrochloric acid into the bladder may end by loosening the phosphatic deposits, which may afterwards be washed out with an evacuator.

Prophylactic.—This is identical with that of renal calculus (see p. 225) as the stone is generally renal in origin. In order to prevent phosphatic concretions, when there is cystitis with mucus, the bladder should be washed out daily with warm saline solution or boracic lotion; this is especially necessary in cases of enlarged prostate.

Operative.—At the present day the surgeon has the choice between removing the stone by a cutting operation—lithotomy—or by crushing—litholopaxy. The latter is the operation of choice, but cases are met with in which lithotomy is safer and better.

Choice of method.—Roughly it may be said that *litholopaxy* is the operation of choice in all cases, whether in an adult or a child, in which the urinary organs are fairly healthy and the stone is not too large. It removes the stone satisfactorily and the patient's convalescence is rapid.

Lithotomy however is advisable:

1. For stones whose longest diameter is three inches or more and which are therefore beyond the power of the ordinary lithotrite.

2. The nature of the stone may affect the question, for a large uric stone is much easier to crush than a much smaller oxalate one, and when there are two or three very hard oxalate calculi it is better to substitute suprapubic lithotomy for litholopaxy.

3. Another condition demanding lithotomy is an insufficiently dilatable bladder, such as will occur in connection with a calculus that has been for a long time in a bladder that is the seat of advanced cystitis; here the bladder walls are thickened and the organ will barely hold more than the stone itself and cannot be dilated sufficiently to allow the lithotrite to be properly manipulated.

4. In stone complicating an enlarged prostate a supra-pubic lithotomy is the more suitable operation as, although the stone may be successfully removed by litholopaxy, the enlarged prostate keeps up a chronic cystitis and fresh calculi are formed soon after the patient has passed out of the surgeon's hands. By supra-pubic lithotomy however not only may the stone be removed but the enlargement of the prostate may also be treated (see Chap. XXXVI.) and the patient may be entirely cured. Even should this not be deemed advisable, the bladder may be satisfactorily drained and the cystitis kept well under and the deposition of fresh stone prevented. Moreover, the use of a lithotrite may lead to serious septic troubles when there is a very congested and enlarged prostate and foul urine.

5. In advanced renal disease supra-pubic lithotomy is preferable to litholopaxy as the free drainage afforded by the former improves the chance of

recovery. At the same time, if the stone be small and the operation likely to be a short one, renal disease does not necessarily contra-indicate litholopaxy as long as the urine is not septic.

6. Stricture of the urethra may lead the surgeon to perform lithotomy in preference to litholopaxy under certain circumstances. A slight stricture may be dilated sufficiently to allow of the introduction of a full-sized lithotrite and therefore need not influence the question. For dense and narrow strictures, however, a perineal lithotomy is probably the best procedure, the simplest plan being to divide the stricture by a Syme's external urethrotomy (see Stricture of the Urethra) and then to prolong the incision up into the bladder as a median lithotomy. The objection to supra-pubic lithotomy in these cases is the difficulty that may arise in the healing of the supra-pubic wound, and it will be necessary to perform an external urethrotomy in addition in order to prevent obstruction to the outflow of urine. Therefore, if the stone be small enough to be extracted by a median lithotomy, there will be no necessity for doing a supra-pubic operation; for a large stone however the supra-pubic operation is a necessity and with it should be combined Syme's perineal section either at the time of the operation or as soon afterwards as possible.

7. In stone in the female the procedure adopted will depend upon the size of the calculus. When this is quite small, the urethra may be dilated and the stone removed through it; for larger stones the lithotrite is very suitable, while for very large ones a cutting operation may be demanded, and a supra-pubic lithotomy is better than any form of vesico-vaginal section, which might lead to a fistula subsequently.

Litholopaxy.—Before operation, a few days' preliminary treatment is necessary. The patient should be in bed, and any cystitis present should receive treatment (see p. 280); although the cystitis may not be cured, it will be much improved. Just before operation the perineum and pubes should be shaved, whilst the glans and the meatus should be disinfected, first with a 1-20 solution of carbolic acid, and subsequently with 1-2000 sublimate. The danger in litholopaxy lies in introducing septic material into the bladder, and every precaution must therefore be taken, notwithstanding the fact that there is to be no cutting operation; the instruments and the operator's hands should be strictly disinfected. The patient, who should have had the bowels thoroughly cleared out overnight, is placed upon the table with the pelvis raised upon a suitable cushion, and the legs encased in long warm stockings. The operation should be done upon a hot-water table if possible, as it may be prolonged, and in any case hot-water bottles should be at hand. The patient may either lie with the legs hanging over the end of the table or he may be tied up in the lithotomy position; the parts should be surrounded with aseptic towels.¹ The anæsthesia must be profound, at any rate in the early stages.

¹An excellent plan is to cut a small hole in the centre of a sterilised towel and bring the penis out through this; there is then less likelihood of the towel becoming displaced during the manipulations.

The urine is first drawn off, and the bladder is washed out with warm boracic lotion until the fluid returns perfectly clear, and then six ounces of the lotion are injected and left in the bladder. The urethra should next be dilated with Lister's bougies (see Chap. XL.) up to a No. 16 or 18 English in order to facilitate the passage of the lithotrite, and the external meatus must be incised downwards if it be necessary to allow this size to pass. This preliminary dilatation is to avoid the risk of damage to the urethra in the neighbourhood of the triangular ligament.

The beak of the lithotrite (which is generally a No. 16 to 18 English in size), is now lubricated and introduced into the urethra whilst the shaft of the instrument is held almost horizontal and parallel with Poupart's ligament, and the penis is drawn up over it until the beak is felt to reach the bulbous portion and cannot be pushed further down. The shaft of the instrument is now gradually rotated into the middle line, keeping the shaft horizontal and the urethra fully on the stretch, and when it reaches this position the handle is gradually raised, so that the instrument becomes vertical and is allowed to slide on into the bladder by its own weight. No force whatever should be used; any difficulty will generally be due to the beak not having been pushed far enough down in the bulb. As soon as the former passes the triangular ligament there is no further difficulty, and, as it enters the bladder, the instrument suddenly slides in easily and can be rotated freely.

The stone is now felt for at the base of the bladder with the jaws of the instrument closed. The movements of the lithotrite must be extremely gentle so as not to displace the stone, and the beak should not be allowed to jar against the sensitive vesical neck. When the stone is felt, the instrument is manipulated so that its beak touches the upper surface of the stone, and then the lithotrite is held firmly in the left hand and is rotated with the right so that the beak is turned away from the stone, when the jaws are separated¹ and the instrument is then rotated back again so that the open jaws lie over the stone which they are made to grasp. The stone now lies in the jaws of the instrument which look directly down on to the base of the bladder. As soon as the stone has been firmly gripped, the lithotrite is rotated through 180° turning the stone right round so that the beak now looks well into the cavity of the bladder. If the stone has been carefully seized there will be no resistance in doing this, whereas, if a fold of mucous membrane has been caught between the jaws and the stone, the latter will not move and must be released and caught again. Therefore the greatest gentleness must be used in practising this manœuvre in order to avoid damaging the mucous membrane.

The jaws of the lithotrite are now pressed firmly on the stone and locked. The surgeon commences to crush the stone by a series of quarter-turns of the handle until the stone is felt to give way. In very hard stones this may require great force, and there may come a time when the operator feels that if more force be used the lithotrite may give way before the stone. Under these

¹ The amount of separation of the blades necessary for grasping the stone is known by the previously ascertained measurements of the size of the calculus.

circumstances it is well to screw down the instrument as firmly as possible and then to wait for a minute or two without attempting to increase the pressure, as it is found that the stone will sometimes fracture spontaneously under a steady strain. As the stone cracks, the fragments fall away from the jaws of the instrument which is then made to pick up fresh fragments exactly as it picked up the original stone, and these are crushed in their turn. As the fragments leave the jaws of the instrument they fall into the base of the bladder, and in that direction they are felt for by the closed instrument and picked up. The whole operation must be done methodically and each fragment must be located separately and grasped with the lithotrite. By proceeding in this manner the stone will be reduced to fragments small enough to be removed through the evacuating catheter. Just before removing the lithotrite to allow this to be done, it is well to rotate the instrument so that the beak looks up into the cavity of the bladder, and then to separate the blades for half an inch or so and, raising the handle of the instrument, to press the convexity of the jaws well into the base of the bladder; this may cause a number of small fragments to fall into the jaws of the instrument, and they can be crushed up still further.

Evacuation should be practised as soon as a considerable proportion of the stone has been reduced to fragments. It is useless to attempt to crush up a large stone completely into minute fragments before evacuating any portion of it, as the *débris* gets in the way of the jaws of the instrument and interferes with the manipulations. The largest sized Bigelow's evacuating tube that the urethra will admit is passed and attached to the evacuating bottle (see Fig. 64). This should be filled with warm boracic lotion and attached to the tube, taking great care to see that the whole apparatus is full of lotion and contains no air. The tap is now turned on and, by gently squeezing the india-rubber ball, a stream of lotion is forced into the bladder, stirring up the sand and *débris*, which, on relaxation of the pressure, is sucked back into the evacuator. This performance is repeated again and again, the *débris* brought from the bladder remaining behind each time in the bottle; it should be repeated until nothing more is withdrawn. A small stone may be sufficiently reduced by one crushing to be removed entirely, but it will generally be found that, after a certain amount of material has been removed, nothing more comes through, although fragments of stone can be heard striking the end of the catheter; should the evacuation have been complete, nothing will be heard as the fluid is sucked out except the rushing sound of flowing water, varied possibly by the sharp flap of mucous membrane against the eye of the catheter which is quite distinct from the metallic ring of a fragment of stone. During the evacuation the eye of the catheter should be turned in several directions so as to make sure that the whole area of the base of the bladder is searched by the stream of fluid. When the surgeon is satisfied that all the fragments are removed, the evacuating catheter is withdrawn and the operation is at an end. If there be fragments left behind that will not come through the evacuator, however, the latter is withdrawn, the lithotrite is introduced a

second time and the same procedure is gone through again, and if necessary a third time, until all the fragments have been removed. Difficulty in withdrawing the evacuator when fragments of stone obviously remain in the bladder may be caused by a fragment becoming impacted in the eye of the instrument, and the obstruction must be removed by passing down the stylet belonging to the instrument before an attempt is made to withdraw it.



FIG. 64.—BIGELOW'S EVACUATING TUBE AND GOLDING BIRD'S EVACUATING BOTTLE.

It is well to empty the bladder of the lotion before withdrawing the evacuator, and to fill it up again with fresh lotion should a second crushing be necessary. Some surgeons employ on the second occasion a lithotrite with little or no fenestration of the female blade, so as to make sure of crushing the fragments to powder, but the danger of this is that fragments of stone may stick between the blades and prevent their proper closure, in which case the withdrawal of the instrument is a matter of great difficulty.

When repeated evacuations give no trace of débris, the operation comes to an end. Before concluding, the surgeon should introduce a sound and search carefully in all directions for any fragment of stone that has been overlooked

as the comparatively frequent recurrence of stone after litholopaxy is usually due to leaving a fragment behind. The length of time that the operation occupies varies according to the size of the stone and the skill of the surgeon. Removal of all the fragments at one sitting, and the carrying out of the necessary manipulations so delicately that the bladder wall is not injured are the secrets of successful litholopaxy, and the surgeon should never be led into leaving behind a fragment of stone by a desire to finish the operation quickly.

After-treatment.—Any shock owing to the length of the operation is easily met by the application of heat and the administration of stimulants. The patient should be kept in bed for a week or ten days, and it may be necessary to draw off the urine for the first few days; frequently, however, he micturates quite comfortably from the first. The bladder does not as a rule require irrigation, but this may be necessary should the urine have been foul before the operation. Irrigation twice daily with a few ounces of warm boracic lotion will then suffice. The diet should be light, with plenty of diluent drinks; urinary antiseptics (see p. 274) should be administered internally. Most adults are convalescent at the end of a week, whilst children may be up two or three days after the operation.

Complications occurring during litholopaxy.—I. *Injuries to the lithotrite.* There is no operation in the whole of surgery where the surgeon is so entirely

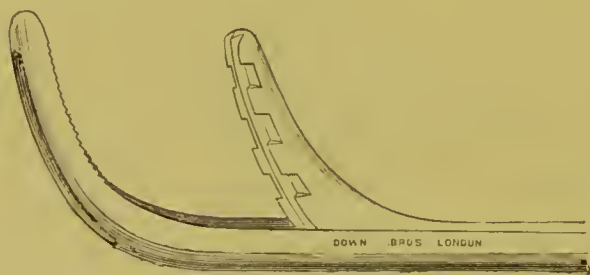


FIG. 65.—THE JAWS OF A FULLY FENESTRATED LITHOTRITE. The male blade fits accurately into the female blade, and no débris can get between them and hamper their closure.

dependent upon his instrument-maker. Unless the lithotrite be of the finest make, it is liable to fracture or to bend under the strain put upon it, and either of these accidents is most formidable. Fracture of the blade of the instrument has occurred more than once. Should it

happen, a supra-pubic cystotomy will be required for the removal of the fragments both of the lithotrite and the stone. This is far better than an attempt to seize the portion broken off in the bladder with a second lithotrite.

A far more serious accident is bending of the jaws of a badly-tempered lithotrite; this renders it impossible to approximate the blades, so that a full-sized instrument cannot be withdrawn from the bladder by anything short of supra-pubic cystotomy followed by filing off the male blade. This accident is more likely to occur in children with large stones, for which, owing to the size of the urethra, a small lithotrite must necessarily be used. It is an argument against lithotrity in children when the stone is large.

The commonest accident to the lithotrite however is clogging of the jaws with débris, and the open-ended female blade (see Fig. 65) has been adopted to avoid this. If the male blade becomes clogged, and it is difficult to screw the instrument home, the best plan is to release the button and convert the

instrument into a sliding one, and then to jam the male down into the female blade sharply and repeatedly. Under no circumstances should an attempt be made to withdraw the instrument by force through the urethra until the blades are satisfactorily home. Sooner than this a supra-pubic cystotomy should be done.

2. *Irritability of the bladder*.—In some patients the bladder is constantly attempting to expel its contents even under deep anæsthesia, and this may not only lead to the ejection of the lotion and so to hampering of the working of the instrument, but fragments of stone may become impacted in the urethra and serious trouble may arise. The anæsthesia must therefore be profound, and in these cases it may be advisable to administer a morphine suppository prior to the operation.

3. *Hæmorrhage*.—In a carefully-performed operation on a suitable subject no marked bleeding should occur. It is chiefly met with in cases of enlarged prostate or when there is a hard oxalate stone in a contracted and inflamed bladder, in which the sharp-pointed fragments injure the mucous membrane. Hæmorrhage due to damage of the bladder wall by the lithotrite, or from laceration of the urethra in dilating it or in introducing large instruments should never occur. Hæmorrhage from an enlarged prostate may be unavoidable, and may be so free as to lead to the abandonment of the operation in favour of supra-pubic lithotomy.

Lithotomy.—There are three forms of lithotomy, viz., supra-pubic, and median or lateral perineal lithotomy. Of these the lateral operation, which was at one time almost universally used, has now fallen entirely into disuse, owing to the greater safety of the supra-pubic operation in the few cases in which a cutting is preferable to a crushing operation; the reasons are as follows:

1. The supra-pubic operation is the ideal method for very large hard stones that a lithotrite cannot crush, and also for multiple calculi. The incision into the bladder can be made of any shape or size that is desired, and the stone can be extracted without bruising the vesical walls, whereas attempts to draw a very large or rough stone through an inadequate incision by the perineal route leads to severe and serious sepsis. Further, supra-pubic cystotomy is very valuable for multiple calculi, because the interior of the bladder is open to inspection and a calculus cannot possibly be overlooked.

2. When there is an enlargement of the prostate, the supra-pubic operation is valuable because it enables the stone to be removed without damage to the gland. Moreover, operative procedures for the cure of enlargement of the prostate may be carried out at the same time (see Chap. XXXVI.) without increasing the severity of the latter operation.

3. The supra-pubic method is absolutely essential for an encysted stone; by no other means can the aperture of communication between the cyst and the rest of the bladder be properly seen, neither can suitable measures be taken for removal of the stone.

4. When there is advanced renal disease or foetid cystitis, the supra-pubic operation is most valuable because there is no risk of septic absorption from injury to the prostatic plexus, whilst at the same time free drainage is provided.

5. In children with stones too large for lithotripsy the supra-pubic operation should be done, although some surgeons still prefer lateral lithotomy. With the former operation there is no danger of making too large an incision into the neck of the bladder and causing permanent incontinence of urine; the bladder is largely an abdominal organ in children, and is therefore even more easily exposed than in the adult.

6. In women the supra-pubic operation is the one of choice if a cutting operation be desirable, as by it not only can the interior of the bladder be thoroughly inspected, but there is no risk of a vesico-vaginal fistula resulting.

Supra-pubic lithotomy.—The reasons for preferring this operation to lithotripsy have already been given (see p. 301), and the operation itself has been described in connection with tuberculous disease of the bladder (see p. 289). The steps of the operation in the two cases are exactly similar up to the point at which the bladder is opened, and we need not therefore repeat that part of the description.

As soon as the incision has been made into the bladder wall, a finger is introduced, and the stone is felt for and extracted with suitable lithotomy forceps slipped in along the finger. The opening in the bladder must be enlarged, if necessary, for the extraction, and in any case it must be steadied, as otherwise the forceps are apt to push it away from the abdominal wall when they are introduced into the bladder. The finger feels for any second stone, which is removed if present, and then the edges of the opening into the bladder are held well up by an assistant, and the interior of the organ is flushed out with warm boracic lotion so as to remove any clot, and its interior is examined with a powerful electric light. The post-prostatic region especially must be examined both by touch and by sight; if necessary a caisson speculum (see p. 291) should be passed down, in order to make sure that no other stone is present. If the Trendelenburg position be assumed, the upper part of the bladder is drawn well away and does not project downwards as it does if the patient be lying flat. The ordinary forehead lamp is usually sufficient, but occasionally a small electric lamp may be introduced into the bladder itself so as to examine its walls more minutely. If the prostatic pouch be very large, an assistant should push the base of the bladder forwards by means of a finger in the rectum, or a rectal bag may be used.

In some cases the calculus is too large to extract through the ordinary incision, and then the latter will either have to be extended or the stone must be split. Kocher's transverse incision (see p. 316) may give more room here. Obviously there are objections to enlarging the opening into the bladder beyond reasonable limits, and it is better to split up a very large stone. This may be done either by a powerful lithotrite, or a hammer and chisel may be employed, the fragments being removed separately afterwards.

After-treatment.—If the urine be aseptic, the incision in the bladder may be sutured completely as for a rupture of that viscus (see p. 272), and a similar after-treatment is employed. If the urine be septic, the wound is treated as in tuberculous disease (see p. 291), and the bladder is drained for ten days. A loose stitch should be inserted where the tube passes into the bladder, and this is tied when the tube is withdrawn. If there be any delay in the closure of the supra-pubic wound, it may be ensured by tying in a catheter *per urethram*.

Encysted stone.—This may give rise to great trouble even with a large supra-pubic opening. When the communication between the pouch and the bladder is comparatively large, it may be possible to dilate the opening and insinuate a scoop around the stone, and thus to shell it out. If this cannot be done, the stone may be fractured *in situ* and the fragments removed, the stone being supported by an assistant's finger in the rectum, or upon a rectal bag. After all the fragments have been removed from the pouch, the latter should be forcibly flushed out with boracic lotion so as to avoid leaving the smallest fragment behind, which will otherwise certainly become the nucleus of a fresh stone; the opening into the pouch should be fully dilated.

When the prostate is much enlarged it should be treated appropriately at the time of the operation (see Chap. XXXVI.). If however the urine be foul and the patient be not in a condition to stand operative treatment, supra-pubic drainage should be employed until the urine is healthy and the patient's strength is re-established, when the wound may be opened up and the enlarged prostate enucleated. Unless this be done, a permanent supra-pubic fistula is very likely to occur, whilst fresh phosphatic stones are almost certain to be deposited in the prostatic pouch.

Perineal lithotomy.—This is a very rare operation nowadays, although formerly it was the one of election. Almost the only cases in which perineal lithotomy is of advantage are those in which there is a stricture of the urethra, when a Syme's external urethrotomy may be combined with a median lithotomy, and the stone thus extracted. The median operation may also be useful for calculi impacted in the urethra and for prostatic stone; it gives a very small incision into the bladder however, and therefore should not be chosen when it is desired to extract a stone of any size, as then the supra-pubic operation will be the safer even if there be a stricture.

Median perineal lithotomy.—The operation is simple, and the results are usually satisfactory, as there is little bleeding, and little damage need be done to the soft parts if the stone be small. The patient is fully anæsthetised, the parts are shaved and purified in the ordinary way, and a suitable staff with a median groove is passed into the bladder, any stricture being, if necessary, dilated beforehand; the patient is then tied up in the lithotomy position. The staff is firmly held by an assistant, who pulls its concavity well up against the arch of the pubes, and also pulls up the scrotum. As a rule the shaft of the staff should be absolutely vertical, although some surgeons prefer to have

the handle somewhat depressed towards the abdomen in order to render the convexity prominent in the perineum. An incision an inch and a half long is made in the middle line of the perineum, extending downwards to about an inch in front of the anus. When the superficial structures have been cut through, the surgeon introduces his left forefinger into the wound and feels for the groove in the staff as it lies in the membranous urethra. The finger-nail is sunk into this, and the knife is slipped over the nail until its point is engaged in the groove, and the membranous and prostatic urethra are opened by pushing the knife along it; the latter should be held horizontal throughout. The left forefinger is slipped out of the groove, but is kept in the wound, serving to press the rectum and soft parts backwards, and the knife is pushed on until the bladder is nearly reached, when the knife is withdrawn, taking care not to depress the handle in so doing, as the rectum or other important parts may be damaged. A director or a probe is passed along the groove of the staff well into the urethra, the staff is withdrawn, and the surgeon passes his finger along the probe into the urethra and through the neck of the bladder, which he dilates sufficiently to allow a small pair of forceps or a scoop to be passed. When the blades of the instrument are well within the prostatic urethra, the finger is withdrawn and the closed forceps are slipped into the bladder; the stone is felt for, the blades are opened and the calculus is seized. When the finger is withdrawn, the rush of urine through the wound generally carries the stone well into the neck of the bladder, so that there is no difficulty in seizing it at once. The stone should be grasped in its shortest diameter and, if this be not done at the first attempt, the calculus should be manipulated until it comes the right way, when it is withdrawn by gentle traction downwards and backwards so as to clear the arch of the pubes. If it should happen that the stone is too large to be extracted in this way, the incision in the prostate may be enlarged by carrying outwards a second incision similar to that for lateral lithotomy, and thus more room may be obtained. If the incision be kept strictly to the middle line there is no bleeding of any consequence.

After-treatment.—A catheter is passed through the perineal wound and tied in; any oozing is easily stopped by packing gauze around it for some hours. The tube is removed in about four days, and the patient is allowed to pass urine *per urethram*. This occurs gradually, all the urine probably passing through the urethra about the end of the fourth week. For the after-treatment of a case in which a stricture has been divided see External Urethrotomy (Chap. XL.).

Lateral lithotomy.—This operation has now fallen into such entire disuse that it is not worth while taking up space by describing it. Anyone wishing to become familiar with it should refer to text-books on operative surgery.

CHAPTER XXXII.

TUMOURS OF THE BLADDER.

TUMOURS of the bladder are not uncommon; they may be simple or malignant, and they may arise from any of the structures composing the bladder.

BENIGN TUMOURS.—With the exception of papillomata these are extremely rare.

Papilloma.—This is the so-called “villous tumour of the bladder”; it is a common affection and is generally benign, although it may be combined with a malignant base. It appears in two forms, the true villous tumour of the bladder with long thread-like processes, or the true warty growth. The villous tumours have long filiform processes of connective tissue supporting blood-vessels and covered by epithelium. The growths are pedunculated, bleed with extreme readiness and are often multiple. It is very common on opening a bladder for a growth of this kind to find one large villous mass with a number of smaller ones around. It would almost seem that they are locally infective for, if a villous tumour be left unoperated upon, the bladder may become studded with little villous masses, and recurrence after operation is not at all uncommon; in fact it may be almost looked upon as the rule. The recurrence does not take place so much on the site of the tumour that has been removed as in the neighbourhood, and apparently is really a fresh development rather than a recurrence.

The warty papillomata are rarer, they are firmer, bleed less readily and are generally sessile.

Fibromata, myxomata, myomata, and angiomata are other benign growths that have been met with in the bladder; the last of these are amongst the rarest, only two or three cases having been reported. We have had a case in which the left side of the bladder was occupied by an angiomatous growth, the only symptom being hæmorrhage without any indication as to its true source, and so profuse that no satisfactory cystoscopic examination could be carried out. The diagnosis of a nævus of the bladder was made before operation, partly by exclusion and partly because there were well-marked superficial nævi on the left thigh and elsewhere on the left side of the body.

MALIGNANT TUMOURS.—**Sarcoma** of the bladder is not at all uncommon. It is usually of the round-celled type and occurs more often in young subjects than in adults.

Carcinoma of the bladder may be primary or secondary to carcinoma of surrounding structures, such as the rectum, uterus or prostate. Histologically it is a cylindrical epithelioma and the growth is usually slow in progress, so that the history may extend over two to four years. Occasionally the growth is much more rapid, and the patient may die from repeated hæmorrhages or from septic decomposition of the urine.

The most common situation of the tumour is the neighbourhood of the trigone or the orifices of the ureters, and the growth soon infiltrates the bladder wall. Infection of the glands and secondary deposits in other organs usually occur late and may not be seen, as the patient may die from exhaustion due to prolonged hæmorrhage.

Symptoms. (a) **Of benign tumours.**—Hæmaturia is often the only symptom and is generally the only one in the early stages. It is usually intermittent, lasting for a time varying from a few hours up to some weeks and is sometimes severe enough to produce profound anæmia. At other times there may be a mere discolouration of the urine at intervals, lasting for a very short time. This hæmorrhage is generally most marked towards the close of the act of micturition and is due to the contraction of the bladder wall upon the growth damaging the latter and squeezing out pure blood. The bleeding usually occurs without definite cause and is not provoked by moderate exercise, although undoubtedly it may be set up by very severe jolting. Examination of the bladder with a sound or catheter, however carefully done, will generally give rise to a smart attack of hæmorrhage. As a rule there is no pain in the early stages and this may be often absent throughout, and the same may be said with regard to other bladder symptoms, such as frequency of micturition. In the later stages, when the growth fills up the bladder to some extent, there may be pain, frequency of micturition and interference with the outflow, due to portions of the growth blocking the neck of the bladder. When there is markedly painful micturition, cystitis has usually supervened.

(b) **Of malignant tumours.**—Hæmorrhage is generally later in appearing than in simple tumours and is usually more persistent, although the blood is often present in smaller quantities than in cases of villous tumour. Pain is a much more constant symptom and may be due in part to the presence of the growth but chiefly to the fact that cystitis sets in comparatively early. The pain may be very severe and is referred to the supra-pubic region, to the perineum, to the bladder itself and to the thighs and loins. Micturition is unduly frequent and the patient's condition is extremely sad.

Diagnosis.—In the early stages this is difficult, as it is hard to determine whether the blood comes from the bladder or the kidney, and the difficulty is increased when the pain is referred to the iliac region or the loin, as is not unlikely to be the case when the tumour implicates the ureteral orifice or is situated in its immediate neighbourhood. The surgeon must not be

too ready to assume, because there is no pain in the bladder region while pain is referred to the ureter or the kidney, that one of these two structures is involved, unless there be some other definite indication. The diagnosis will be made by a consideration of the characters of the hæmaturia (see p. 171) by microscopical examination of the urine, which often shows bladder epithelium in large quantity or fragments of tumour, and by cystoscopic examination which is better than any attempt at examining with a sound. Cystoscopic examination (see p. 259) under these circumstances must be carefully done otherwise, especially in villous tumours, hæmorrhage is very apt to occur and obscure the view. A time should be chosen when the urine is comparatively free from blood.

If a cystoscope be not at hand, useful information may sometimes be obtained by the use of a metallic catheter with a large eye. The instrument is introduced, the bladder is distended with three or four ounces of boracic lotion and the interior is examined carefully, when possibly a soft mass which is not as definite nor as hard as a stone may be felt, and its outline may be made out between the point of the catheter in the bladder and the finger in the rectum. Then, when the examination of the interior is complete, the finger is suddenly removed from the end of the catheter and the fluid is allowed to escape rapidly, whilst the eye of the catheter is directed towards the trigone, which is the usual seat of these growths. A portion of the tumour may be washed into the eye of the catheter and may be pulled off as the instrument is removed. Sometimes important information may be gained by the fact that mere examination of the bladder with the catheter provokes free bleeding which is almost certain to be due to growth, generally of a villous character, rather than to an inflammatory condition.

By bi-manual examination, which should be undertaken under complete anæsthesia, one may feel thickenings in spare persons especially in the case of malignant tumours; even villous tumours may be made out as a softish increase of resistance at some particular spot. It is seldom necessary to perform a supra-pubic cystotomy for the mere purpose of diagnosis, as it is generally possible to determine in other ways whether a tumour be present. The supra-pubic exploration however is valuable for settling the nature of the tumour.

Treatment.—When a tumour of the bladder is diagnosed, the possibility of eradicating it must be at once considered, and no time should be lost if there seems any hope of doing this successfully. Waiting merely permits the patient to become worn out by repeated hæmorrhages and possibly allows cystitis to occur and so renders operative interference much more serious. There can be no question that in the case of an innocent growth the sooner the bladder is opened and the tumour removed the better it is for the patient; when the growth is malignant, various other points have to be taken into account.

(a) **Palliative.**—This is not very satisfactory and mainly resolves itself into attempts to keep the urine unirritating, combined with the administra-

tion of sedatives locally to the bladder and generally to the nervous system. The hæmorrhage may sometimes be kept under control by the use of gallic acid (10 grs.), turpentine (20 min.), pil. plumbi cum opio (10 grs.) or liquid extract of ergot (1 dr.) internally. The last drug however must be used with extreme caution and it is best to reserve it for cases in which the hæmorrhage is severe enough to threaten the patient's life as, owing to the advanced age and broken-down condition of the subjects of malignant bladder tumours, serious physiological effects may be produced.

Locally the bladder may be irrigated with tincture of hamamelis (one part to three of water) or perchloride of iron (20-60 minims to the oz.); when the latter is used it should be washed away with boracic lotion after a short time. In cases of very severe bleeding, extract of supra-renal substance (gr. xx. ad $\frac{3}{4}$ j) or a solution of adrenalin chloride (1 in 1000) may be injected into the bladder, left there for a quarter of an hour and then washed out again with boracic lotion. Should the hæmorrhage persist or should there be severe cystitis which is beyond control, permanent drainage may be established above the pubes, as the pressure of a catheter through the perineum is usually intolerable. An opening in this situation also enables the surgeon to investigate the condition of affairs and there is less risk of sepsis. Should the tumour be situated on the anterior surface of the bladder however the perineal route is the better. Both these operations have been described (see pp. 289, 309).

Sometimes however the patient's condition may be so bad that either operation is out of the question, and in that case supra-pubic drainage may be effected by puncture. The patient is given an anæsthetic, the bladder is distended with three or four ounces of fluid, a small median incision is made just above the symphysis pubis through the skin and superficial fascia, and then a suitably curved trochar and cannula is thrust in a direction somewhat downwards and backwards through the anterior vesical wall. When the cannula has entered the bladder, the trochar is withdrawn and the cannula is fixed in position by tapes and worn for about a week, so that the opening may become established, when it is removed and a suitable india-rubber tube, provided with a shield and tubing leading into a urinal, is substituted. This small operation is hardly ever accompanied by bad results and may be performed with little or no shock to the patient, for whom it secures permanent and thorough drainage.

(b) Operative. (a) **Of villous tumours.**—Whenever the surgeon is of opinion that the tumour can be removed, it should be done by a supra-pubic cystotomy, which renders the interior of the bladder so accessible that the tumour can be dealt with almost as easily as if it were upon the surface. A median perineal section does not admit of this to anything like the same extent. The operation has already been described (see p. 289). The bladder is opened by the usual vertical incision in the great majority of cases. Occasionally however the cystoscope may reveal a growth in such a position

that it will be dealt with more easily through a transverse than through a vertical opening (*vide infra*). The "caisson" speculum (see p. 291) is most useful for these cases, as by it the growth can be isolated, dried and inspected in a good light, and its exact relations ascertained.

If the tumour be a villous papilloma, it is seized in a pair of forceps and cut away, either with suitable scissors or by a small elliptical incision, together with a small portion of the whole thickness of the mucous membrane from which it springs. While this is being done, an assistant, who takes no further part in the operation, presses the base of the tumour forward with a finger in the rectum, or a rectal bag may be used. It is always advisable to remove the area of mucous membrane from which these tumours spring, although they are non-malignant in nature. There is usually little bleeding, which is easily stopped by temporary pressure with forceps. Ligatures are nearly always unnecessary. Unless the elliptical wound thus made be very small, it is well to insert a stitch or two in its centre, and for this purpose the finest catgut should be employed in a fully-curved Hagedorn needle, and the ends should be cut quite short; the sutures soon become absorbed, and do not give rise to trouble. After the main growth has been removed, the whole surface of the mucous membrane is gone over carefully with the speculum in order to detect any smaller ones, which, if found, should be similarly snipped off. When all have been removed, the bladder is sutured completely in the ordinary way (see p. 271) if the urine be aseptic, a drainage tube being inserted from the abdominal incision into the pre-vesical space. The after-treatment has already been described (see p. 274). Recovery is rapid and the patient may be up in three weeks.

Should there be free oozing, which has not quite stopped when the operation is completed, it is well to introduce a tube through the supra-pubic opening, as otherwise clots may cause distension of the bladder and leakage through the stitches. A good plan is to introduce two or three loose catgut sutures through the muscular coat of the bladder opposite the point at which the tube emerges, and to leave their ends long, so that they can be tied and the cut edges of the bladder thereby approximated when the tube is withdrawn. A similar plan should be adopted with the abdominal muscles and skin. The tube may be withdrawn in two or three days, the bladder in the meanwhile being washed out twice daily so as to get rid of the clots. A separate drainage tube should be inserted in the pre-vesical space. In these cases a large mass of dressing will be required, and the best plan is to surround the tube and the wound with the ordinary gauze dressings, while around this, and especially about the groins, are placed large pads of sterilized compressed moss to soak up the urine. The dressings will require to be changed 4 or 6 times daily.

When the tumour is very extensive and involves the mucous membrane to a greater extent, it may be very difficult to work properly through the ordinary vertical incision, which may then be enlarged by carrying a transverse incision outwards from the lower end of the vertical one on one or both sides right

down to the bone,¹ and detaching with a chisel a portion of the pubes to which the rectus on one or both sides is attached. This gives plenty of room, especially if the patient's thorax and pelvis be slightly raised so as to relax the abdominal muscles to the full; after the operation the detached portion or portions of bone may be fixed in position again with a few tacks.

The result of these operations is sometimes very satisfactory but is often disappointing, because after a time fresh villous tumours form and the bladder may have to be opened several times. It will often be found that the recurrence has not taken place on the site of the old growth if the latter has been effectually removed, but that fresh ones occur in other parts of the mucous membrane. Herring suggests that in these cases the bladder should be frequently irrigated with a solution of nitrate of silver² not only to prevent bleeding but to cause shrivelling of the growths.

(b) **Of malignant tumours.**—Attempts at removing malignant growths of the bladder are very disappointing, although temporary freedom from symptoms is sometimes attained; this does not, however, usually last longer than a few months, and is only what is to be expected from the difficulty of getting sufficiently free of the growth. Occasionally, however, the tumour is so small and superficial that the patient's prospects are good, and in any case it is advisable to do a supra-pubic cystotomy when a malignant tumour has been diagnosed, as, if it be found impossible to remove it with any chance of success, supra-pubic drainage will at any rate afford relief to the patient's sufferings. The condition of a patient left to die of this affection is miserable in the extreme; supra-pubic drainage not only relieves the symptoms, but the progress of the growth may be to some extent arrested, as the constant contractions of the bladder cease to irritate it and give rise to hæmorrhage.

When supra-pubic cystotomy is performed as a palliative measure, the operation is done as already described (see p. 289). An india-rubber tube is tied in until the rest of the wound has healed, when a suitable gum-elastic or silver tube attached to tubing which passes into a urinal is substituted for it, and the patient can get about in comparative comfort and keep himself dry. As a rule the bladder should be washed out by the patient himself daily with a little warm boracic lotion, and both the tube in the bladder and that to the urinal should be in duplicate and should be carefully cleaned and boiled each time before it is used again.

When the operation is done as a radical measure, the wider transverse

¹ This closely resembles the operation recommended by Kocher, who makes a transverse incision through the abdominal wall from a point just above and internal to the internal abdominal ring to a corresponding point on the opposite side. The recti are cut through transversely just above their insertion into the pubes, and the front of the bladder is thus freely exposed, and can be opened by a transverse incision also.

² A "standard solution" of nitrate of silver is made of the strength of one grain of the salt in a dram of distilled water slightly acidulated with nitric acid. Half a dram of the "standard solution" in four ounces of distilled water at the body temperature is injected into the bladder daily as long as the bleeding persists; it is a good plan to increase the strength of the drug very cautiously until one or two drams of the "standard solution" are used.

incision into the bladder recommended by Kocher (*vide supra*) will probably be required; all three incisions, viz., those through the skin, the abdominal wall and the bladder may be transverse and excellent access is thus obtained. The actual mode of removing the tumour will be determined by the conditions met with. In some cases large portions not only of the mucous membrane and sub-mucous tissues but of the whole thickness of the muscular wall and even of its peritoneal covering have been removed. In other cases an extra-peritoneal excision of portions of the bladder has been practised, whilst in others again the ureters have been grafted into the colon or the vagina and the remainder of the bladder has been removed.

Attempts to remove the growth by tearing or scraping it away are to be deprecated, as it is impossible to remove the entire mass in this manner and the irritation it causes will probably only make the tumour increase more rapidly. The precise steps of the various operations are too varied to detail here. They will be found in Jacobson's *Operations of Surgery*. Speaking generally it may be said that, when the operation necessarily involves opening the peritoneal cavity, this should be done before proceeding to the excision. The peritoneum is opened just above the bladder, the patient is placed in the full Trendelenburg position and the intestines are packed off so as to isolate the bladder, which is then emptied of urine, and the growth is freely excised. The bleeding from the divided bladder wall is arrested, preferably by torsion, and the resulting wound is sutured as for a rupture of the viscus (see p. 271) the mucous membrane being united separately by a fine continuous catgut stitch, after which the muscular and serous coats are brought together by a double row of Lembert's sutures. The opening in the extra-peritoneal surface of the bladder is then temporarily plugged so as to prevent the escape of blood and urine while the abdomen is cleaned up, the cloths are removed and the peritoneum is closed in the usual way. Finally, the wound in the anterior wall is sutured and the bladder is drained by a tube introduced above the pubes for the first few days so as to obviate any tension upon the stitches (see p. 291). When the growth is situated on the anterior wall of the bladder just above its neck, various procedures have been suggested for its exposure. In any case a transverse incision through the abdominal wall will be required, and this should be done by detaching a portion of the pubes (see p. 316) in preference to dividing the insertion of the rectus.

Should the growth involve one of the ureters, this need not be in itself considered a bar to operation if there be a chance of eradicating the disease. The peritoneal cavity should then be opened, the ureter divided obliquely sufficiently far from the tumour, the growth excised, and the proximal end of the ureter grafted into the bladder (see p. 198).

The entire bladder has been removed in women. The ureters are diverted into the vagina at a preliminary operation, while at a later date the entire bladder is removed. This does not seem to be a particularly difficult operation. In a man the ureters would have to be transplanted into the sigmoid flexure.

Attempts have been made to resect portions of the wall of the bladder covered by peritoneum without excising the latter. This is feasible in some cases, but it does not seem to us to have any advantage, as the organ can be sutured just as efficiently when the peritoneal coat has been removed also.

SECTION III.—AFFECTIONS OF THE PROSTATE AND URETHRA.

CHAPTER XXXIII.

TRAUMATIC AND INFLAMMATORY AFFECTIONS OF THE PROSTATE.

INJURIES OF THE PROSTATE.

INJURIES from external violence are very rare and are either punctured wounds caused by falls upon pointed instruments or contusions in the perineum ; injuries from within may result from the passage of instruments. The importance of these injuries is the danger of extravasation of urine and septic infection, the latter being particularly prone to occur in the large venous prostatic plexus.

Treatment.—The main points are to avoid extravasation of urine and septic infection ; free drainage must therefore be provided, and should be combined with measures for securing asepsis of the urine.

When the injury takes the form of a severe perineal contusion, there may be so much inflammatory swelling as to render drainage of the bladder by a catheter difficult, and it will then be best to perform median perineal section (see p. 309) at once and drain the bladder by a perineal tube (see p. 310). This may be left out in ten days or a fortnight, and a catheter tied into the bladder through the urethra¹ and the perineal wound allowed to heal. Should the prostate be very severely damaged, it may be difficult to pass a catheter or even to find the way into the bladder after a perineal section, and the best plan will then be to open the bladder above the pubes, when the vesical orifice of the urethra can be identified and a catheter passed from the supra-pubic opening down through the urethra where it may be tied in. In addition to this, urinary antiseptics (see p. 274) should be given, the bowels should be kept freely open, while morphine and belladonna suppositories may be required for the relief of pain.

¹ For details as to tying in a catheter, see p. 345.

INFLAMMATORY AFFECTIONS OF THE PROSTATE.

Inflammation of the prostate may be either acute or chronic, the acute form affecting either the glandular follicles or the organ as a whole. Sometimes, however, when suppuration occurs it is peri-prostatic.

ACUTE PROSTATITIS.—This is an infective condition often connected with gonorrhœa; it may also be due to injury of the prostatic urethra by dirty instruments or by a surgical operation; it may follow the use of strong urethral injections, while gout, alcohol, and dietetic excess seem to play some part in its production. Vesical or prostatic calculi may give rise to acute prostatitis, and the affection may be met with in connection with stricture of the urethra; it is also said to occur from undue indulgence in exercises, such as bicycling and horse-riding, and from sexual excess.

In the cases not due to sepsis, resolution frequently occurs. When of gonorrhœal origin, the acute form may pass on into the chronic, while in septic cases suppuration is common and may occur in connection with the follicles, in which case the abscess usually bursts into the urethra, or in the peri-prostatic tissues, when the pus finds its way either into the rectum or the ischio-rectal fossa. Very rarely, a communication may form between the urethra and the rectum or the perineum, and a urinary fistula may result.

Symptoms.—These are usually characteristic. There is a sensation of heat and weight in the rectum, with frequent micturition and painful defæcation. The patient is unable to get comfortable in any position, there is marked pyrexia, and sometimes there are rigors. Digital examination shows the prostate to be enlarged, tender, hot, and fluctuating; soft spots may be felt when suppuration is established. This latter occurrence is usually accompanied by retention of urine and great pain on catheterisation. When this occurs in patients who have urethritis, the urethral discharge usually diminishes or ceases altogether.

The condition is easily distinguished from gonorrhœal cystitis in which there is no enlargement of the prostate, but marked vesical tenesmus.

Treatment.—The first indication is to insure rest to the parts and to diminish the local congestion. The patient should be confined to bed, as the intimate connection of the prostate with the levator ani makes it certain that any movement will affect the gland. The pelvis or the foot of the bed should be raised, the bowels should be kept freely open, first with a dose of calomel (grs. iii-v), and subsequently by sulphate of magnesia administered daily, while suppositories of belladonna and morphine should be employed once or twice daily to relieve pain and diminish the contractions of the levator ani. Hot perineal fomentations or a sitz bath as hot as the patient can bear it should be used as frequently as possible and are very comforting. If a bath be employed, the patient should sit in it for from half an hour to an hour at a time, the water being renewed as often as may be necessary in order to keep it up to the proper temperature. If these measures fail, half a dozen leeches (see Part I., p. 5) may be applied to the perineum, followed by

hot boracic fomentations and large enemata of hot water¹ (100°-105° F.). The diet should consist of milk, and large quantities of diluent drinks may be given. Alcohol should be avoided, and urethral medication should be stopped. No catheter should be used unless it be absolutely necessary, but if required a soft instrument must be employed. Digital examination of the prostate should be avoided as much as possible during the acute stage unless the symptoms point to the formation of an abscess.

If this treatment fails to relieve the symptoms, it will probably mean that an abscess is forming; this may be indicated by a fluctuating spot in the prostate felt from the rectum, or, in cases of peri-prostatitis by swelling in the perineum. As soon as there is definite evidence of suppuration, the abscess should be opened from the perineum; if left alone, it will burst either into the urethra, which is usually the case with follicular abscesses, or into the rectum, the perineum or the ischio-rectal fossa. An abscess should always be prevented from bursting into the rectum if possible, as very serious and protracted suppuration may result.

Operation.—Before opening a prostatic abscess from the perineum, the latter should be shaved and purified in the usual way, and the patient



FIG. 66.—COCK'S DOUBLE-EDGED KNIFE FOR PERINEAL SECTION.

put into the lithotomy position under full anæsthesia. The forefinger of the left hand is introduced into the rectum with the palmar surface upwards and its tip resting upon the apex of the prostate, or upon the fluctuating spot previously detected. A sharp double-edged knife, such as Cock's (see Fig. 66), is then thrust into the median raphé of the perineum about an inch in front of the anus, and pushed steadily onwards towards the tip of the finger in the rectum. The patient should lie with the symphysis pubis, the umbilicus and the point of the chin in the same straight line, and the long axis of the knife should be kept in this line. As soon as its point is felt to enter the capsule of the prostate, the knife is withdrawn, enlarging the skin wound upwards and downwards by a sawing movement as it does so, and a pair of sinus forceps is pushed in through the opening so as to tap the abscess, the finger being maintained in the rectum until this is done. As soon as pus begins to flow, the finger is withdrawn from the rectum and purified, and then the abscess cavity is opened up, the finger of the right hand being introduced to break down

¹ If the patient be strong, the following mixture may be given :

R	Vini antim.,	-	-	-	-	℥ 10.
	Potass. bromidi,	-	-	-	-	grs. 25.
	Tinct. hyoscyami,	-	-	-	-	ʒss.
	Infus. buchu ad	-	-	-	-	ʒj. every three hours.

any septa. A full-sized drainage tube (No. 24) should be introduced into the cavity and stitched to the skin of the perineum. The urethra is not necessarily opened in this operation, although it may give way either as a result of the manipulations or from sloughing of the thinned mucous membrane subsequently if the abscess be actually pointing into it. In the latter case a urinary fistula will follow, but it generally closes rapidly as the abscess contracts. Any hæmorrhage may be easily controlled by packing gauze firmly around the drainage tube. Should much packing be required, the tube should be of gum-elastic instead of india-rubber, so as not to be unduly compressed.

If the abscess has burst into the rectum before the patient is seen, the anus should be fully dilated (see p. 6), a large bivalve speculum introduced, and the opening of the abscess exposed and enlarged so as to give free escape to the pus. It is not advisable to make an independent perineal incision to establish better drainage in these cases, as in all probability a fæcal fistula would follow it. It is well to stuff the orifice with strips of iodoformed gauze for a few days to prevent it from closing prematurely. After the third day the stuffing may be left out and the rectum should be irrigated daily with boracic lotion after the bowels have acted, so that no fæcal material may collect about the opening.

Should a perineal urinary fistula have followed a prostatic abscess, the sinus should be freely opened up and scraped, and a catheter tied into the urethra (see p. 345). Healing usually occurs readily under this treatment.

Acute prostatitis and prostatic abscess complicating enlarged prostate are very difficult to treat. In all cases a soft rubber catheter must be tied in, as retention always complicates the affection, and of course aggravates it.

CHRONIC PROSTATITIS.—This usually follows an acute attack or is a sequel of gonorrhœa, the gonococcus finding its way into the glandular follicles. It may also be due to the use of unduly strong urethral injections or to excessive coitus. There is considerable enlargement of the prostate from interstitial inflammatory exudation and this may lead to permanent enlargement of the organ if it lasts for any time.

Symptoms.—There is a sense of weight and discomfort in the perineum, with frequent and sometimes painful micturition, whilst the urine contains filamentous threads formed by the secretion from the prostate. There may be a gleety discharge, especially noticeable in the morning, and occasional spasm of the perineal muscles, followed by the escape of a clear or slightly opalescent fluid. Per rectum the prostate is enlarged and generally tender on firm pressure, and there is usually some tenderness on defæcation.

Treatment.—The affection is very rebellious, and is apt to produce much mental depression. In the early stages, entire abstinence from alcohol and sexual excitement of all kinds must be enforced. The patient need not be confined to bed, but exercises such as bicycling or riding, which entail perineal pressure, should be forbidden, and the semi-

recumbent position should be assumed as much as possible. A light non-stimulating diet must be prescribed, the bowels must be kept freely open by saline aperients and, if there be frequency of micturition, a mixture containing an alkali in combination with tincture of hyoscyamus and infusion of buchu, will be useful. Sedatives are rarely called for. In the more chronic cases sexual intercourse need not be forbidden.

In the local treatment hot sitz baths are valuable. In obstinate cases counter-irritation by the application of iodine or blisters to the perineum is useful. In all cases any exciting cause must of course be examined for, and if possible removed. If the condition follow an attack of gonorrhœa, topical applications to the prostatic urethra, by means of the urethroscope are exceedingly valuable; mild solutions, *e.g.* five grains to the ounce of nitrate of silver, should be employed at first, and repeated at intervals of three to seven days, gradually increasing in strength. If the stronger solutions be used in the early stages there is a risk of setting up acute inflammation. This subject is dealt with more fully in connection with the treatment of gonorrhœa (see Chap. XXXIX.).

In the very long-standing cases, tonics, such as iron and nux vomica, should be given in combination with ergot (℥ x.-xx. of the liquid extract, three times a day), whilst sea-bathing or a sea voyage are often very useful in young men who have had gonorrhœa for a prolonged period and are much run down in health and spirits. In these cases also, the passage twice a week of a well-warmed bougie, as large as the urethra will admit, is very useful. It dilates the prostatic urethra and evacuates superficial collections of mucus in the orifice of the glands. Here also the application of nitrate of silver to the prostatic urethra through the urethroscope will be of value (*vide supra*). In all these cases, examination of the vesiculæ seminales per rectum must be made as, if inflammation of these structures be present, the prostatic affection is not likely to disappear until it has been cured (see Chap. XXXV.).

Gouty prostatitis.—Prostatic irritation may undoubtedly be connected with gout. The attack generally occurs at night. There is urgent painful micturition, the urine is very acid and deposits urates and mucus in large quantities. The prostate is very sensitive for a time, and retention of urine may occur. The treatment is mainly that for the milder forms of acute prostatitis combined with the administration of drugs suitable for gout, and the affection readily subsides.

CHAPTER XXXIV.

PROSTATIC CALCULI: PROSTATIC TUMOURS: TUBERCULOSIS OF THE PROSTATE.

PROSTATIC CALCULI.

PROSTATIC calculi are usually small concretions found in the dilated follicles of the gland, especially when the organ is enlarged. They are small and numerous, and may be collected together to form a considerable mass, consisting essentially of inspissated secretion. True prostatic calculi however, which are probably due to salts deposited on the concretions just mentioned, may be found; they are composed of phosphate and carbonate of lime, and are brown in colour, comparatively small, often faceted, and of a porcelain-like consistency.

Vesical calculi which have escaped from the bladder and become embedded in the prostate, or which lie in the prostatic urethra and go on increasing there, must be distinguished from the true prostatic form. These calculi are readily diagnosed after removal by the fact that their nucleus consists of oxalates, urates, or uric acid, whereas the true prostatic ones do not show these salts; vesical calculi differ also in shape, as they tend to project into the bladder and become elongated and hour-glass shaped.

SYMPTOMS.—Prostatic concretions seldom give rise to much trouble; sometimes however they cause symptoms very similar to those of enlarged prostate. They are generally detected either on rectal examination or on passing a bladder sound, by which the rough, characteristic grating of a calculus is detected before the beak of the instrument is in the bladder. When the finger is introduced into the rectum, the stones, which are nearly always multiple, can easily be felt between the sound and the finger.

TREATMENT.—In the majority of cases a median perineal section (see p. 309) should be done, the membranous urethra opened, the finger introduced into the prostatic portion, and the calculi removed with forceps.

TUMOURS OF THE PROSTATE.

CYSTS due to dilatation of the glandular follicles are not uncommon. They are present in many cases of enlarged prostate, but in the great majority they give rise to no symptoms. When they are so large as to project into the bladder they are generally mistaken for an enlarged prostate. Fluctuation may possibly be recognised in them.

Treatment.—If a cyst giving rise to symptoms be diagnosed, it should be opened and enucleated either through a median perineal incision when it is situated on the lower aspect of the organ or by a supra-pubic cystotomy when it projects into the bladder cavity.

Echinococcus cysts are sometimes met with in the prostate, but it is doubtful whether they occur in the organ itself or in the cellular tissue around, as the tissues between the prostate and the rectum are a favourite seat of cysts of this nature.

Treatment.—When the cyst is low down and comparatively small, an attempt should be made to reach it from the perineum by a transverse curved incision in front of the anus. Free drainage must be provided through the perineal wound, and there is, of course, always the risk of septic infection. When the cyst is larger and projects upwards towards the anterior abdominal wall, the best treatment is to perform laparotomy, and then, fixing the cyst in the abdominal wall, to open and drain it just as any other hydatid in the peritoneal cavity. These cysts should never be opened from the rectum.

CANCER of the prostate is fortunately not very common, but it should be remembered that it may occur both in an enlarged and in a normal prostate. It is characterised by enlargement and fixation of the gland, with severe pain, and much bleeding when the tumour ulcerates; excessive pain is a very characteristic symptom. Micturition is also extremely painful and difficult.

Treatment.—Radical treatment is not to be recommended. Many attempts have been made to remove the prostate, but the disease has always recurred. As a palliative measure, the best plan is perhaps to establish supra-pubic drainage by puncturing the bladder with a trochar and subsequently introducing a catheter (see p. 314).

TUBERCULOUS DISEASE OF THE PROSTATE.

Tuberculosis of the prostate is rarely primary; it is usually secondary to similar disease elsewhere in the genito-urinary tract. In it there is an irregular enlargement of the lateral lobes of the organ, and the tuberculous masses undergo caseation and either become calcareous or lead to the formation of abscesses. Occasionally spontaneous arrest occurs and the tuberculous material becomes encapsuled.

Symptoms.—When the urethral mucous membrane is implicated, the patient usually complains of dull aching in the perineum accentuated by

defæcation or by exertion. Micturition is painful and frequent, and the last drops of urine are often blood-stained. The pain is referred to the tip of the penis or the neck of the bladder, and is most marked at the end of micturition. Retention may occur from swelling in and around the prostatic urethra.

If the urethral mucous membrane be unaffected, there may be few symptoms beyond a sense of fulness or uneasiness in the perineum combined with slight discomfort on defæcation when the bowels are at all confined.

The disease is readily detected by digital rectal examination, as the prostate, instead of being smooth and elastic, contains a number of nodules of varying size and is often very tender. These nodules vary in consistency and tend to soften, so that fluctuation may be detected. When this is the case, retention of urine and much pain on micturition occur.

An abscess forming in connection with a tuberculous prostate not infrequently bursts into the urethra, leaving a ragged ulcerating cavity into which urine makes its way. At other times, abscesses situated in the posterior part of the prostate may perforate the rectum, and further extension of the suppuration then takes place, and the opening may extend into the urethra and lead to the formation of a recto-urethral fistula. The abscess may also make its way down into the perineum and lead to sinuses which usually end in urinary fistulæ. The condition is very serious and very difficult to treat.

Treatment.—In the early stages the treatment must be palliative. Rest, perfect hygiene and the avoidance of sexual excitement, combined with a general tonic treatment, are the main points. The use of instruments should be avoided, as they only irritate the prostatic urethra.

When it is obvious that palliative treatment is not succeeding and that suppuration is occurring, the serious risks of allowing the abscess to burst spontaneously must be avoided by evacuating the pus through a perineal incision as soon as its presence is determined. Here the incision already described for acute abscesses will not suffice, as there may be considerable difficulty in reaching the small scattered abscesses, and a curved incision with its convexity forwards just in front of the anus is the best. A sound is passed into the bladder so as to define the position of the urethra, and, as the wound is deepened, the urethra is pushed forwards and the rectum backwards until the levator ani is divided. If the abscess be of any size, it is usually detected at this stage and the finger passes into a ragged cavity containing pus, which should be scraped out as thoroughly as possible, great care, however, being taken not to scrape through the wall of the urethra or the bladder, which must be carefully defined by the sound; after this has been done, the cavity is packed with iodoformed gauze. A catheter should be tied in for a week or ten days and the packing renewed at the end of the second day and subsequently daily.

If the abscess has burst into the urethra, a similar operation should be done, as without it the patient is practically certain not to get well.

A soft catheter should be passed each time the patient desires to micturate until the wound has healed. Healing usually occurs satisfactorily

if all the cheesy material has been scraped out, but a sinus may remain for some time, and it may be necessary to open up the wound again and scrape it out.

In very obstinate cases of perineal urinary fistula due to this cause, a supra-pubic cystotomy may be done with advantage so as to stop the flow of urine over the cavity. The more elaborate operation of excision of the prostrate would only be justifiable if the affection could be attacked sufficiently early to enable the whole focus of disease to be removed, provided always that the surgeon is sure that there is no similar disease elsewhere. Theoretically, of course, this measure is the proper procedure, and it can be fairly easily done through a curved perineal incision. In practice however the surgeon will never be sufficiently sure that the disease is primary to justify operative procedures that would undoubtedly be too severe for the patient if the disease were secondary to genito-urinary tuberculosis elsewhere.

When however the abscess has burst into the rectum, a perineal incision should be avoided, because a rectal fistula would be almost certain to result. It is better to dilate the anus and enlarge the opening of the abscess into the rectum, scraping out the cheesy deposit from it.

CHAPTER XXXV.

PROSTATORRHŒA: AFFECTIONS OF THE SEMINAL VESICLES.

PROSTATORRHŒA.

IN this affection there is a discharge of prostatic fluid accompanied by marked neurasthenic symptoms. In addition to the discharge of fluid, there may be other nervous conditions, such as spasm of the sphincter vesicæ, with arrest of the flow of urine and some pain, and there is often great hyperæsthesia of the prostate, and a variety of abnormal sensations. The fluid that escapes from the urethra may be copious, and resembles white of egg, and its presence gives rise to profound mental depression in the mind of a neurotic patient, who generally reads quack literature on the subject, and is under the impression that he is suffering from what is called spermatorrhœa. There is generally some increased frequency of micturition and sexual irritability, and there may be a certain amount of chronic inflammation of the prostatic urethra; a history of antecedent gonorrhœa or masturbation is not uncommon.

TREATMENT.—This is most difficult, as nearly every one of this type of patient deserts his medical man for someone else before he has been long under treatment. In the early stages benefit may be obtained by passing the largest-sized bougies possible, which press out the secretion from the follicles, and empty them for the time being. The urethra should then be washed out, and topical applications can be made to the mucous membrane (preferably a strong solution of nitrate of silver) through the urethroscopic tube. This subject is dealt with more fully in connection with the treatment of gleet.

Tonics should always be administered, and the patient's attention should be diverted from his condition as much as possible, and he should be assured that it is in no way serious. Due regard must be paid to general hygiene, and the bowels must be regulated, while cold water douches, shower-baths, and regular exercise are all advisable. Sandalwood oil in 10-minim doses, three times a day after meals, belladonna,

ergot, or strychnine, are all valuable in different cases. If the patient suffers from nocturnal emissions, 20-30 grains of bromide of potassium about three hours before he goes to bed may check them. In bad cases it is well to insist upon vigorous treatment in a nursing home or a hospital.

AFFECTIONS OF THE VESICULÆ SEMINALES.

The only conditions requiring notice are inflammation and tuberculous disease of the organs.

VESICULITIS or **INFLAMMATION OF THE VESICULÆ SEMINALES** may be acute or chronic, and usually follows gonorrhœa. *The acute form* rarely goes on to suppuration, and usually accompanies prostatitis or other gonorrhœal complications. It gives rise to irritability of the bladder, and pain in the region of the prostate and perineum; the finger in the rectum may detect the enlarged and tender vesiculæ.

Treatment.—This is generally simple, as the mischief usually subsides when the acute condition which it accompanies passes off. The patient should rest in bed, diluent drinks should be employed, and hot rectal injections are beneficial.

Chronic vesiculitis is more serious on account of the extreme mental depression which it almost invariably excites in patients suffering from it. This is one of the conditions present in the so-called prostatic hæmorrhæa, the vesiculæ, which are hard, swollen and tender to the finger in the rectum, containing a considerable quantity of turbid discharge which runs out into the urethra, and so escapes.

Treatment.—General hygienic treatment and the administration of tonics should be adopted, and a plan has been introduced by Fuller, of New York, termed “stripping the seminal vesicles,” which he advocates as not only the best, but as the only method of treatment. The plan is based on the fact that the presence of the secretion in the vesicles distends them and keeps up the inflammation, and it consists in introducing the finger into the rectum, preferably with the bladder full, and, while pressing down the bladder from above the pubes, applying pressure to the vesiculæ seminales from behind forwards, so as to expel their contents into the urethra. This is done several times, until the vesiculæ are empty. Considerable irritation may follow the early attempts and Fuller recommends that it should not be repeated oftener than once a week, or once a fortnight, but he says that, if this be steadily persevered with, the obscure local troubles of which the patient complains, gradually disappear, and with them the severe mental depression.

TUBERCULOSIS OF THE SEMINAL VESICLES is very rare as a primary condition, but as a secondary affection it is common. It is nearly always present in tuberculous epididymitis, and it frequently follows tuberculosis of the bladder and prostate. It is very chronic in nature, and rarely forms an abscess. When an abscess does occur, it

may burst into the rectum or the bladder, or it may make its way down behind the prostate and burst in the perineum. Tuberculous peritonitis and tuberculous cystitis are apt to follow extension of the disease in this region, whilst the prostate will almost invariably become involved.

Treatment.—The surgical treatment is practically entirely limited to cases in which suppuration has occurred, although some surgeons have performed elaborate operations for the removal of tuberculous vesiculæ seminales before suppuration has taken place. It is doubtful, however, whether an operation of this kind should ever be performed, as it must be very extensive and the affection is usually secondary and therefore does not warrant it.

As soon as suppuration in the neighbourhood of the vesiculæ seminales is discovered, a perineal incision should be made and the surgeon should work his way behind the prostate towards the abscess, so as to evacuate it by the perineum and thus avoid the risk of its bursting into the rectum or bladder or both. The procedure is quite similar to that for tuberculous disease of the prostate (see p. 326) except that the separation must be carried on between the prostate and the rectum until the abscess cavity is reached.

CHAPTER XXXVI.

ENLARGEMENT OF THE PROSTATE.

ENLARGEMENT of the prostate is very common in patients over fifty-five. It is rarely seen before fifty, and comparatively seldom commences after seventy. Its frequency is variously given by different authors ; apparently a considerable number of men over the age of fifty-five are the subjects of the affection although only a comparatively small proportion have symptoms. Simple enlargement of the organ does not necessarily give rise to any symptoms beyond some increase in frequency of micturition unless the enlargement be irregular or excessive or in some way interferes with the proper emptying of the bladder.

The weight of the prostate may be increased from the normal (about half an ounce) to two or three ounces or more. The nature of the enlargement varies. In the rarer form it is a true hypertrophy, but it is more common to find an overgrowth of the fibrous elements so that the enlargement is mainly fibrous in nature. Local enlargement, which gives rise to definite tumours of the gland, also occurs and is frequently spoken of as adenoma of the prostate ; the condition may involve a part or the whole of one lobe. The term, adenoma, is hardly correct, as the enlargements are rarely as completely encapsuled as a true adenoma is ; they are more in the nature of lobular outgrowths from the main body of the prostate to which they are connected by a pedicle. This particular form is most common in the so-called enlargement of the middle lobe, which is generally a polypoid outgrowth from one of the lateral lobes rather than a posterior enlargement of the prostate, and which is the form in which the enlarged portion falls over the orifice of the urethra and blocks it. The prostatic enlargement as a rule is very irregular and may lead to great distortion of the urethra and in that way may also interfere with micturition. There is always an increase in length of the prostatic urethra, and it is flattened from side to side ; as the prostate enlarges the new tissue pushes its way upwards towards the bladder cavity inside the sphincter vesicae. A ring or collar is often met with around the neck of the bladder or there may be the so-called enlarged middle lobe projecting upwards and causing trouble.

Practically nothing is known concerning the etiology of this affection and none of the suggestions need be discussed, as they have no real bearing on treatment.

There may be various important *changes in the urinary organs* secondary to the affection; their nature and degree depend on the amount of obstruction and the length of time that it has lasted. As the affection causes a certain amount of difficulty in evacuating the bladder, the muscular wall of the organ becomes hypertrophied in order to overcome this. The cavity of the bladder remains of normal size or becomes larger than usual, whilst the muscular bundles become much hypertrophied and the condition known as "fasciculated bladder" occurs. In this the hypertrophied muscular bundles stand out prominently on the surface of the bladder and between them the mucous membrane forms marked depressions. If the obstruction continue to increase, the mucous membrane in these depressions tends to be forced outwards and form saccules which project from the outer surface of the bladder and communicate with its interior by comparatively small orifices between the muscular bundles. These are of importance because they may reach a large size and a stone not infrequently becomes deposited in them; they are lined with mucous membrane and the submucous tissue is generally considerably thickened. If the obstruction continues unrelieved, the hypertrophy of the bladder will give way to atrophy and dilatation, so that the bladder becomes much distended and thinned and its surface is smooth and without fasciculi, although any sacculi that have already formed remain. In advanced cases there may be ulceration of the mucous membrane.

If the backward pressure be persistent, its effects rarely remain limited to the bladder. The ureters become dilated, their valvular openings being insufficient, and there is consequent dilatation of the pelvis of the kidney and a certain amount of hydronephrosis. This may lead to polyuria and nephritis. The pressure also tends to obliterate or flatten the ejaculatory ducts. This is a point not usually noticed, because the disease generally occurs in old men, and sexual desire is more or less lost in the advanced stages although it may be exaggerated in the early ones.

SYMPTOMS.—These vary with the degree and nature of the enlargement. Sometimes a prostate which is felt per rectum to be very large may give rise to no appreciable symptoms, whilst on the other hand there may be very severe trouble in an organ that from the rectum hardly seems to be enlarged at all. One of the earliest symptoms is increased frequency of micturition, but this often passes quite unnoticed unless it happens to disturb the patient at night and even then he may say that there is no frequency during the day. It will however usually be found on enquiry that the daily frequency is as great as or even more marked than that during the night. A more prominent symptom is an urgent desire to pass water which cannot be resisted by an effort of the will; moreover the stream cannot be stopped during the act of micturition as is the case in a healthy subject. Besides this, the patient generally notices that urine does not flow immediately he attempts to pass

water and that there is a marked diminution in the power of projection ; after a time the stream drops vertically downwards. Micturition takes unduly long and urine is apt to escape after the patient thinks the act is complete.

These symptoms increase as time goes on, and the nocturnal frequency becomes so great as to interfere seriously with the patient's sleep. There is not only difficulty in passing water but there is severe straining in the effort to overcome the obstruction and this may lead to hæmorrhoids, rectal tenesmus or prolapse. As the bladder walls begin to atrophy, there is still more delay before micturition can be commenced and after the act the patient constantly experiences a sensation that he has incompletely emptied his bladder ; this is probably due to the fact that there is a considerable amount of residual urine in the post-prostatic pouch. There is little or no constant or severe pain however as long as there is no cystitis.

The examination is made partly *per rectum* and partly by instruments passed *per urethram*. The finger in the rectum will note the undue size of the organ and any irregularity in outline or consistency ; sometimes the prostate is so large that it may be felt bi-manually. By the use of an instrument the length and direction of the prostatic urethra can be determined. The ordinary gum-elastic catheter moulded to the usual curve for the introduction of instruments into the bladder will not pass readily, mainly because the curve of the urethra is now altered. The best catheter is a gum-elastic instrument which should be at least an inch or an inch and a half longer than those in usual use and which should be furnished with a stylet to which the necessary bold curve can be imparted. If further information be required, the cystoscope may be employed and by it the projection of the prostate into the bladder may be seen. A very important point to make out in examining any case is the amount of residual urine present, as this largely influences the line of treatment to be adopted. The patient is made to empty the bladder as completely as possible and a catheter is passed immediately afterwards and any urine left behind is drawn off and measured. This is the "residual urine" which may vary from a drachm or two up to several ounces. The character of the urine must also be taken into account and the bladder should be sounded to ascertain whether a stone be present.

COMPLICATIONS.—*Retention of urine* generally occurs in advanced cases, but it may also be met with at a comparatively early period, when it is probably due to congestion of the mucous membrane about the vesical orifice ; chills, over-feeding or drinking are potent causes of this. In the other cases the retention occurs from the continuous growth of the enlarged prostate, especially that form projecting upwards and backwards into the bladder, the so-called enlargement of the middle lobe, which acts as a ball-valve over the urethral orifice. These cases are often distinguished by the fact that, after the patient has commenced to pass urine, the stream may suddenly stop owing to blocking of the urethra. In other cases again retention takes place gradually and is partly due to the increasing size of the

prostate and partly to the atrophy of the bladder walls, which have little or no muscular power left; here there may be a form of the so called "false incontinence" of urine, namely retention with overflow, the bladder becoming distended and the urine dribbling away.

One of the most serious complications of advancing prostatic enlargement is *cystitis*, which usually occurs at some period of the case; the most frequent cause of this is the introduction of organisms upon imperfectly sterilised instruments. In a healthy bladder this would have very little harmful effect unless the organisms were very virulent, as they would be simply washed out again; in the case of enlarged prostate however, with much residual urine and an unhealthy condition of the bladder walls, a single introduction of an imperfectly sterilised catheter will almost certainly lead to decomposition of the urine and grave cystitis. The gravity of this affection depends very largely upon the nature of the organism which gives rise to it; the most common is probably the colon bacillus. Pyogenic organisms may also be introduced and may cause a very severe form of cystitis, and it is possible that in very rare cases decomposition may be set up by bacteria which have been brought down from the kidney.

Calculi may form in the post-prostatic pouch and are a very common and troublesome complication.

Hæmaturia is very frequent at some stage of enlargement of the prostate even when no instrument has been passed; and it then probably comes from dilated veins about the vesical orifice. When it is slight in amount it causes little trouble, as it escapes by the urethra; it may be severe however and much blood may find its way into the bladder where it clots and adds greatly to the patient's discomfort.

Other complications are *urethritis* and *epididymitis*, which depend to some extent at any rate upon injuries caused by instruments after the commencement of "catheter-life." Urethritis especially is a very serious complication as it renders the passage of a catheter painful and adds largely to the patient's sufferings. *Prostatitis* and *prostatic abscess* may also occur and may be followed by *urinary infiltration*. *Urinary fever* is also met with.

TREATMENT.—This may be palliative or operative, the former method consisting of various hygienic measures, the administration of drugs and the use of catheters, whilst the latter aims at removing the obstruction.

Choice of methods.—The determination as to whether any given case should be treated by palliative or operative measures is sometimes fraught with difficulty. In quite the early stages, when the symptoms are slightly if at all marked, it is not usual to think of operative interference. When, on the other hand, the patient's life is a burden to him and he suffers extremely from pain, restlessness and sleeplessness, and when ordinary palliative measures have failed, the question of radical treatment comes strongly to the fore. The difficult cases are those in the intermediate stage when it is obvious that the affection is definitely, although possibly slowly, progressing and when therefore there is a temptation to think that operative measures employed

early while the patient is in good condition would give better results both immediate and remote than could otherwise be obtained. This point at the present moment is exercising the minds of many surgeons, but sufficient experience has hardly yet been accumulated to enable any authoritative statement to be made upon the subject.

(a) **Palliative.**—**In the earliest stage** an important point is to remember that the enlarged prostate is generally congested and that anything, however trivial, that may favour this should be therefore avoided. The diet should be light and non-stimulating, with regular meals and little alcohol; at most some light red or white wine may be permitted. The quantity of fluid taken should be diminished as much as possible, and effervescing liquids should be avoided. No food should be taken for two or three hours before bedtime and stringent precautions should be taken against constipation. Exposure to cold and excessive bodily exercise should be carefully avoided. The patient should also never run the risk of placing himself in the position of being unable to evacuate the bladder when necessary, as it very frequently happens that the troublesome symptoms date from an occasion upon which retention has occurred from inability to empty the bladder when it was necessary. The bladder should be emptied at least every six or eight hours, or oftener if necessary. The act should always be performed in the standing position as the bladder is thus much more completely evacuated.

The only drugs of any value seem to be ergot, tincture of cantharides and *nux vomica*. When there is irritability of the bladder the ordinary vesical sedatives, such as tincture of hyoscyamus in half-drachm doses, may be used. Many patients seem to derive benefit from a stay at some of the baths, such as Wildbad, Marienbad, or Vichy. Other methods, such as the application of nitrate of silver to the prostatic urethra, injections into the gland, massage, electricity and mechanical pressure exerted by passing large instruments, etc., have been recommended but are of little value.

In the second stage—the period marked by definite “residual urine” but without cystitis—no patient should be allowed to go on long without having the bladder occasionally emptied by a catheter, as the presence of residual urine tends to increase the congestion and is a constant source of danger. The regular withdrawal of residual urine diminishes the congestion of the prostate, but at the same time it must be remembered that the employment of an instrument exposes the patient to a certain amount of risk. Dr. White of Philadelphia gives the following rule for cases in which the urine is aseptic:—If on examination the residual urine amounts to about three ounces, the catheter should be passed once daily. If it reach six ounces, the catheter should be passed twice a day and once extra daily for every two ounces above this quantity. Should there be complete retention, the instrument should be used at regular intervals, say every three or four hours. When the catheter is only used once or twice a day it should always be passed immediately before the patient goes to bed so as to empty the bladder completely and make sure of some hours’ rest.

When the urine is aseptic there is no need to irrigate the bladder in addition to evacuating it; should cystitis occur however this will be necessary.

The management of the case when cystitis is present is referred to below (see p. 344).

Catheters.—The best catheter for the patient to pass for himself is Jaques's red-rubber catheter, which can generally be got in fairly easily, and with which it is impossible for the patient to injure himself; it also has the great advantage that it is easily disinfected and is not spoiled by boiling. A No. 6-8 English is the best size, as it is too big to get caught in the folds of the urethra, and too small to do any damage.

When the urethra is so distorted that the red-rubber instrument fails to pass, the coudé or bi-coudé catheter (see Fig. 67) is very useful. It is soft and not likely to do harm, but its great disadvantage is the difficulty in disinfecting it. Gum-elastic catheters are much employed in England. They are moulded on a stylet to a proper curve and may be bent to any shape after immersion in hot water, and they retain the curve imparted to them when allowed to cool. They are very easy for the surgeon to pass, but they are difficult for the patient himself to use. They also suffer from the disadvantage that they are difficult to sterilise without damage. Metal instruments should be rarely used, as the eye is apt to scratch the urethra, and in the hands of an unskilled person they may do serious damage. If one be employed, it should be an inch and a half to two inches longer than the usual instrument, and it should have the bold prostatic curve; a No. 8 or 9 is the best size.

Disinfection of catheters.—The greatest care must be taken to avoid infection in passing the instruments, and the first point that arises is the question of the disinfection of the catheter itself. This is readily done by boiling in the case of metal or red-rubber instruments, and with the latter form a good plan is to let the patient carry it in a

test tube of fair size in which the catheter lies coiled up. When required for use the tube is filled with water above the level of the catheter, and may be boiled over a spirit-lamp or gas flame. Then after use, the instrument is thoroughly rinsed in warm water and put in the test tube again, which



FIG. 67.—CATHETERS FOR USE IN ENLARGED PROSTATE. The right-hand one is a coudé catheter, the other bi-coudé.

should have an indiarubber cork, and may be furnished with a metal case. The catheter thus remains in the fluid in which it has been boiled until it is again required for use.

Disinfection of gum-elastic instruments is however a matter of difficulty. They are ruined both by boiling and by strong antiseptics such as 1-20 carbolic solution, and, although 1-1000 sublimate may be syringed through them and the catheter immersed in the solution for a short time with impunity, they must not be kept long in it, and they seldom last long even then. A usual method is to immerse the catheter, which is syringed through after use with warm water, in a long tube containing a solution of 1-1000 perchloride of mercury in glycerine where it is kept until required for use, when the sublimate is rinsed away with hot water. Of late formalin has been largely employed for the disinfection of catheters, and more recently a convenient plan has been introduced of exposing the catheter to the action of tri-oxy-methylene in suitable receptacles. This is a powerful antiseptic and is likely to be valuable.¹

The precautions necessary to avoid infection do not stop at the cleansing of the catheter, as a perfectly aseptic instrument may nevertheless introduce organisms into the bladder from the lubricant employed or from the urethra, etc. The usual lubricant has for its base either some oily substance or glycerine. Of these, glycerine is the safer and may be used either as pure glycerine or *horo-glyceride*, both of which are aseptic. The only objection to them is that, by the time the catheter reaches the bladder, most of the glycerine is washed off and the lubrication is imperfect, and therefore it may be necessary to withdraw the catheter more than once and re-lubricate it. This objection does not apply to greasy materials such as vaseline. The lubricant may be applied to the instrument by squeezing it out of a collapsible tube, and this is a good method, the only objection being that the lubricant must be spread over the instrument by the finger, and that therefore the surgeon or the patient must carefully cleanse the hands before doing so. Another plan is to use sterilised oil, which is poured from a bottle over the catheter so that there is no necessity for touching the latter with the finger. Under no circumstances should the instrument be introduced either into an oil bottle or an ointment jar.

The surgeon's or the patient's hands must be thoroughly disinfected before passing the catheter, and the orifice of the urethra must also be dealt with. The patient should always be strictly enjoined to wash the hands and disinfect them with carbolic solution, and the glans penis should also be washed, and the meatus mopped out with a small twist of cotton wool out of a 1-2000 sublimate solution. The strictest possible

¹ Formalin is a 40 per cent. solution of formic aldehyde in water and is used as a disinfectant in a strength of 2 per cent. to 10 per cent. watery solution. In using tri-oxy-methylene the drug is dusted over the bottom of an air-tight box or other suitable receptacle, and the catheters are exposed to its action by being laid upon shelves or trays which are made of gauze or of perforated metal. Formic aldehyde is given off slowly when the drug is exposed to the air and has a powerful germicidal action.

precautions must be enforced with patients who have to pass the soft rubber catheters, as the instrument is seized first close to the orifice, and the fingers are shifted further and further along the instrument as it passes down the urethra, and therefore it may be infected by dirty hands throughout its whole length. A patient who has to pass catheters for himself frequently should have an outfit consisting of a Jaques' catheter in a test tube containing boracic lotion, a small spirit-lamp, a small bottle of carbolic acid for the fingers, and another of sterilised oil or boro-glyceride for the instrument. These can be packed into a case which the patient should always carry with him.

On the early occasions the catheter should be passed in the recumbent position, as the patient may become faint if the urine flows off rapidly while he is in the erect position. When he becomes accustomed to using the catheter however, it should be passed in the erect position, as the bladder is then more rapidly and completely emptied.

Catheter fever.—Attacks of so-called "catheter fever" may occur in any patient who has to use catheters. This is an attack of shivering accompanied by high temperature, which in ordinary cases lasts only a few hours and then passes off. It may however be followed by suppression of urine or by septic renal mischief. The exact pathology of catheter fever is uncertain. By some it is held to be always due to a septic infection, but this can hardly be the case, as the rigor may follow the passage of a catheter within a few moments, and, unless we suppose that toxins are absorbed through some scratch in the prostatic urethra, there would not be time for any bacterial development before the onset of the symptoms. To suppose that a sufficient amount of toxine can be taken in on a catheter which has undergone even moderate cleansing is absurd. It would seem that true catheter fever is a reflex nervous phenomenon, and the suppression of urine occurring in connection with it must also be reflex. Should the catheter fever be complicated by sepsis, the original mischief goes on to a more serious septic condition. In order to avoid the occurrence of this complication, the instrument should be passed only in the patient's own house in the first instance, and if he be elderly, he should be kept in bed before this is done.

The treatment of an attack of catheter fever is the administration of stimulants and the application of hot bottles until the attack passes off. When there is a history of these attacks after passing instruments, it is well to give a dose of 5-10 grains of quinine an hour or two before the catheter has to be passed, and to take special precautions to guard the patient from exposure during the proceeding. As a rule the tendency gets less as time goes on, and the patient then passes the catheter without any trouble.

(b) **Operative.**—Some of the operative measures are of a palliative character, whilst others are curative and are directed towards the diminution or removal of the enlargement of the prostate. The palliative measures have not much to recommend them. Their chief rôle is to

relieve complications such as retention, cystitis, or hæmorrhage, and they have little effect upon the general condition.

Perineal drainage.—Perineal urethrotomy was at one time extensively employed to obtain a more direct and therefore a shorter route for catheterisation and, as an extension of this, the incision was actually carried up through the obstructing ring or lobe of the prostate. These measures may give temporary benefit in so far as they improve the cystitis, but they are followed by no diminution in the size of the prostate.

Supra-pubic drainage.—Supra-pubic cystotomy as a palliative measure has taken the place of the perineal operation, and is quite legitimate for cases in which the urethra has become so irritable that no catheter can be passed, or in which the obstruction is so severe that no instrument can be got through. Supra-pubic puncture may of course be required as a temporary measure for retention of urine which cannot be otherwise relieved, and when this condition recurs very frequently and there is very severe cystitis, supra-pubic cystotomy may with advantage follow supra-pubic puncture; in some cases a permanent fistula has been established by suturing the walls of the bladder to the skin and, when cicatrisation has occurred, fixing a tube permanently in the opening and carrying it into a suitable urinal.

This operation relieves the patient of much of the distress due to the passage of catheters or to cystitis, and he is therefore comparatively comfortable. At the same time however it is not curative in any sense, and it is distressing to the patient to have a permanent supra-pubic fistula, and, now that the operation of prostatectomy has been more developed, it is probable that any surgeon will hesitate to deliberately condemn the patient to a supra-pubic urinary fistula if it be possible to do anything more radical for him.

Witzel has suggested that, if a supra-pubic cystotomy be done for these cases, the opening should be planned upon the principle underlying his operation of gastrostomy (see Part VI., Sec. I., p. 221), the catheter being removed in the intervals between micturition, when the valvular action of the opening is supposed to prevent leakage. We may say of cystotomy in general that it must be regarded as purely palliative, and may be employed in cases of acute retention of urine where catheterisation is impossible, in severe and painful cystitis, in serious hæmorrhage into the bladder, and in cases complicated by false passages. In these conditions, it may be either a permanent or a temporary measure; it is of course a preliminary to the operation of supra-pubic prostatectomy (see p. 341).

Cystopexy.—In connection with supra-pubic operation, Professor Goldmann has pointed out that complete power of micturition has been regained after such a measure, and this he attributes to adhesion of the anterior wall of the bladder to the abdominal parietes which brings about mechanical opening of the urethral orifice. Upon this observation he has founded a method of treatment in which the bladder is cut down upon as for supra-pubic cystotomy, but, instead of being opened, the anterior wall is drawn into the

upper angle of the wound and secured there by sutures taking up the muscular coat only and so inserted as to put the bladder wall on the stretch from the neck of the organ upwards. Professor Goldmann states that good results have followed, and patients who had been previously condemned to catheter life have been able to pass water naturally. This suggestion is however quite recent, and no sufficient experience has enabled us to judge of its actual value. Coming from a surgeon of the standing of Professor Goldmann however it is well worth trying.

Among the more radical methods of treatment there are three that require consideration, namely, prostatectomy, Bottini's galvano-cautery method, and the operations upon the testicle and vas deferens.

Prostatectomy.—Although removal of portions or the whole of the prostate is an operation that has been known for many years, it has been much improved and systematised recently. The earlier operations were conducted upon a rather haphazard plan, a median perineal cystotomy being performed, and portions of the prostate projecting into the bladder being felt for and snared or torn away. These operations were not infrequently followed by good results, and the operation was then more systematically taken up, and in this country it was especially advocated and first put upon a satisfactory basis by McGill of Leeds, who practised removal of the obstructing portions of the prostate through a supra-pubic cystotomy opening. Since his publication, much literature has accumulated on the subject, and the operation has been done both by his method and by the perineal route. More elaborate procedures have been introduced, all tending to the more complete removal of the organ, and quite recently a very complete operation has been advocated by Freyer, by which practically the entire prostate is removed. McGill's operation consisted essentially in gaining access to the prostate by supra-pubic cystotomy and either removing an enlarged middle lobe which obstructed the outflow of urine or getting rid of portions of the prostatic ring which formed the obstruction; this was affected either by cutting or snaring or by grasping the obstructing portion of the prostate in powerful forceps and twisting and tearing it away. In many cases, especially in those where portions of the prostate project into the bladder and act as a valve over its orifice, much relief is obtained, the function of micturition is restored, and the chief cause in the formation of the post-prostatic pouch is so diminished that the residual urine and the consequent tendency to cystitis almost entirely disappear. The method is however by no means perfect, and the restoration of function is by no means complete except in cases where a mass projecting upwards against the internal orifice of the urethra is practically the sole trouble, and there is no doubt an appreciable mortality associated with the operation, death from hæmorrhage or sepsis being not uncommon.

Various operations have therefore been introduced which aim at still more radical treatment, the object being to remove the prostate more or less completely, and not only the portions that project into the bladder. Some of

these are performed from the perineum or by the sacral route, but in them the great difficulty is to deal effectually with that portion of the prostate above the prostatic urethra; until recently it could be hardly said that they had gained sufficient success to entitle them to a prominent place amongst recognised methods of treatment.

In carrying out McGill's operation some surgeons, ourselves amongst the number, have given up tearing off the obstructing portions with forceps and have divided the mucous membrane over the prominent portion and shelled out the mass. It is true that our own attempts have been limited to the part projecting into the bladder and the upper portion of the prostate, and we have been accustomed to look up this as merely another way of doing McGill's operation. Freyer however has gone further than this, and has introduced a procedure which, judging by the published records, seems destined to take a prominent place in the radical treatment of these cases. In it the removal is not limited to the upper portions of the prostate, but embraces the whole of the enlarged mass; it appears to be followed by remarkably successful results as regards recovery of function.

Freyer opens the bladder supra-pubically in the ordinary manner and investigates the condition of affairs. One or two fingers of the right hand are then introduced into the bladder, and the mucous membrane over the projecting portion of the tumour is torn through all around the urethral orifice. The finger is then gradually insinuated around the outer surface of the enlarged mass, and its coverings are peeled off. As already said, the mass projecting into the bladder finds its way between the mucous membrane and the sphincter vesicæ, and therefore the projection is only covered by mucous membrane. The finger is kept close to the enlarged prostate and insinuated between the true capsule outside and a sort of fibrous sheath which immediately surrounds the organ until the whole of the enlargement is gradually enucleated. This requires a good deal of force, and the prostate has to be pushed forcibly up by the fingers of the other hand in the rectum so as to render its lower part accessible. In some cases the gland comes away in two halves, but it may be taken away whole. Anteriorly the finger generally slips into a sulcus between the two lobes, and thus the urethra may be separated from the tumour. The identification and separation of the urethra is facilitated by a stiff gum-elastic catheter passed into the bladder and kept in position throughout the operation which involves continuous hard work for ten to fifteen minutes; at the end of this time the prostate, lying loose within its capsule, can be pushed into the bladder, seized with forceps and pulled out of the wound, leaving a large cavity traversing the centre of which is the prostatic urethra. The wall of this cavity is formed by a certain amount of muscular tissue forming the sphincter of the bladder and, although free oozing takes place from the surface, according to Freyer no dangerous bleeding occurs, and he does not spend any time in attempts to check it; the cavity is merely washed out with saline solution at about 105° F. A drainage tube of the largest size is introduced through the supra-pubic opening, so as to carry off

any clots that form in the bladder. The supra-pubic wound is then stitched up around the tube. the catheter is withdrawn from the bladder and the patient is put back to bed.

After-treatment.—Any shock is appropriately treated (see Part I., p. 141), and the drainage tube is kept in for at least five days, when it is taken out and the supra-pubic wound is allowed to close, which it usually does in two or three weeks; no catheter is passed *per urethram*, and apparently the prostatic urethra adheres without trouble to the sides of the cavity left after removal of the prostate. In one or two of Freyer's cases the prostatic urethra was removed with the prostate; but even here no trouble apparently resulted and the recovery of function was perfect.

Freyer¹ states that he has now operated on 21 cases by this method and of these 19 recovered complete power of micturition; in none was there any incontinence or subsequent trouble. Only two of the 21 have died; one became maniacal, and one died quite suddenly some days after the operation, death being attributed to heat-stroke. This gives a mortality of something over 10% and, considering that the operation was done in old people whose strength was already exhausted by the suffering through which they had gone, this is a very remarkable result; should these brilliant results be borne out by future experience, it is clear that the operation must take a high rank and prove itself superior to any other method with which we are at present acquainted. One must not however found too positive an opinion on the comparatively small number of cases recorded, especially as other surgeons are said to have had much trouble with hæmorrhage.

Alexander's operation.—American surgeons, notably Professor Alexander and Dr. Parker Sims,² have advocated removal of the prostate by the perineal route. The difficulty here is the distance at which the upper part of the prostate lies from the perineum. Sims overcomes this by introducing an instrument with a dilatable bulb into the bladder; when this is in position the bulb is distended and firm traction is made upon it so as to pull the prostate bodily downwards; it also serves to arrest bleeding during the operation by its pressure. After the prostate has been enucleated, a drainage tube is introduced into the bladder through the perineum, and the organ is continuously drained and frequently irrigated. The drainage tube is removed by the seventh day and sounds are then passed at intervals through the urethra. The author speaks highly of the method and records 21 cases without a death and with marked improvement in the functional result. None had incontinence, the residual urine disappeared and the patients were able to hold their water for from two to four hours during the day whilst some have been able to pass the entire night without being disturbed. The question as to whether the enucleation of the prostate is best effected by the supra-pubic or the perineal route is one that the future must decide; as far as we can judge, the evidence points towards the supra-pubic method as that of choice. Although the perineal opening is the most dependent, it is

¹ *British Medical Journal*, Nov. 8th, 1902.

² *Ibid.*

not satisfactory from the aseptic point of view and the operation involves division of the membranous and prostatic urethra.

Whichever route be adopted, we have little doubt that enucleation is the method of choice in the treatment of enlarged prostate. When catheter-life must otherwise be entered upon, it may well be urged if the patient be in a good condition to stand the operation, as he will thereby be relieved of the risks that must attend the habitual use of a catheter. When a patient who has entered upon catheter-life is constantly troubled with cystitis, the operation is even more urgently required as, unless it be done, the health is almost certain to be broken down and the patient to be so worn out that he passes beyond the reach of surgical measures.

The galvano-caustic method.—This method (Bottini's) aims at burning away the obstructing portions of the prostate at the neck of the bladder by a special form of electric cautery introduced through the urethra and heated when it is in actual contact with the obstructing mass so as to burn a deep furrow through it. We ourselves have no experience of this operation, which for a long time made little or no progress in public favour. Recently however many surgeons have adopted it and advocate it strongly. Judging by the results of subsequent cystoscopic examination, the groove burned by the instrument tends to heal up and practically disappear, but nevertheless, even in these cases, considerable improvement seems to follow. It is said that about 75% of the cases are improved, a certain proportion of these being permanently cured, whilst about 15% get no benefit; there is apparently a mortality of 7%–10% attaching to the operation which is very much the same as in Freyer's operation although the ultimate results can hardly be claimed to be so certain.¹ The operation has been followed by acute epididymitis, retention, incontinence or even fatal suppression of urine.

Operations upon the testicle and vasa deferentia.—*Castration.*—Castration was practised for the cure of this condition almost simultaneously by Ramm of Christiania and White of Philadelphia and is founded upon the fact that atrophy of the prostate occurs after double castration. There seems to be no doubt that a remarkable improvement has followed the operation in a considerable number of cases, the prostate gradually undergoing atrophy, the cystitis disappearing and the power of micturition being regained. At the same time, however, an unusually high mortality has followed this apparently simple operation. Some patients die of acute mania, others go steadily downhill without any definite lesion, whilst others again, although they escape a fatal issue, become morose and lose their mental faculties to a very marked extent. The exact percentage of cases in which this occurs is not clear; some surgeons have had an almost uniformly bad experience, whilst others have had very little. But there can be no question that there is a serious risk of these psychical disturbances, and the mortality does not seem to be less than that of the more logical and complete operation of prostatectomy.

¹ Full details will be found in Vol. 53 of the *Deutsche Chirurgie*, where the operation is strongly advocated.

In order to lessen these risks it has been proposed to remove one testicle only, preferably that on the side on which the hypertrophy is most marked; improvement has followed this procedure, although it is very imperfect and in no way approaches that following removal of both organs.

Vasectomy.—In order to get rid of the risk attaching to castration, Mr. Reginald Harrison has proposed to resect a portion of the vasa deferentia so as to produce gradual atrophy of the testes without complete destruction, hoping thereby to produce the same effect upon the prostate as after castration. A certain amount of improvement has followed vasectomy, especially when done very early before the enlargement is great and before complications have occurred; but it is only slight so far as we are able to judge. Our own experience is that these operations upon the testicles and vasa deferentia are disappointing.

At the present time therefore one may say that the general procedure is to use the catheter in the early stages of the affection but that, should complications arise or catheterism become painful and difficult, some more radical measure seems to be required and that this should be prostatectomy. We cannot help thinking that, as time elapses, the operation of prostatectomy will come more into vogue and that moreover it will be done much earlier in the case before the patient is the subject of various complications; indeed it seems to us logical to recommend the operation strongly as soon as the condition of the prostate renders it certain that catheter-life will have to be entered upon unless it be done.

Treatment of complications.—The treatment of *cystitis* must follow the lines already laid down for that affection (see Chap. XXVIII.). When it occurs in the early stages of the disease, local measures should be avoided as far as possible and the various general measures already recommended (see p. 281) should be had recourse to. Should the cystitis continue and become chronic, however, local treatment will be necessary. In the first instance irrigation of the bladder (see p. 285) should be adopted; instillations (see p. 285) may be called for provided that they do not set up irritation. In worse cases continuous drainage (see p. 286) may be necessary. In very bad cases the bladder may have to be opened, preferably above the pubes, and permanent drainage adopted, should the patient be unable to stand a radical operation or should he refuse it.

Epididymitis is not an infrequent complication, and in order to avoid it patients who are the subjects of prostatic enlargement should wear a suspensory bandage, and the greatest possible care should be taken in securing asepsis of the instruments used. The treatment for the affection is similar to that for epididymitis from other causes and is separately described. It has been suggested that, when there are frequently recurring attacks of epididymitis, vasectomy should be performed, not only for its effect upon the prostate but in order to cut off direct communication between the testis and the urethra. This recurring affection however will bring strongly forward the question of prostatectomy, as it is practically impossible under these circumstances to

continue passing catheters ; should prostatectomy be declined or be inadvisable it may be necessary to establish permanent drainage (see p. 339).

For free *hæmaturia* the best procedure is to introduce a large catheter in the first instance and tie it in, in the hope that its pressure will arrest the bleeding. When however there is much clot in the bladder, the eye of the catheter will get blocked, and the clots must be removed as soon as possible as not only will they lead to acute retention, but decomposition followed by very serious cystitis will occur. As a rule this is easily done by attaching an evacuating apparatus to the catheter and sucking the clots up through the tube. After this the bladder and prostatic urethra may be irrigated with a solution of equal parts of tincture of hamamelis and water, with $\frac{1}{2}\%$ solution of nitrate of silver, or with adrenalin chloride (1 in 1000). Drugs given inter-

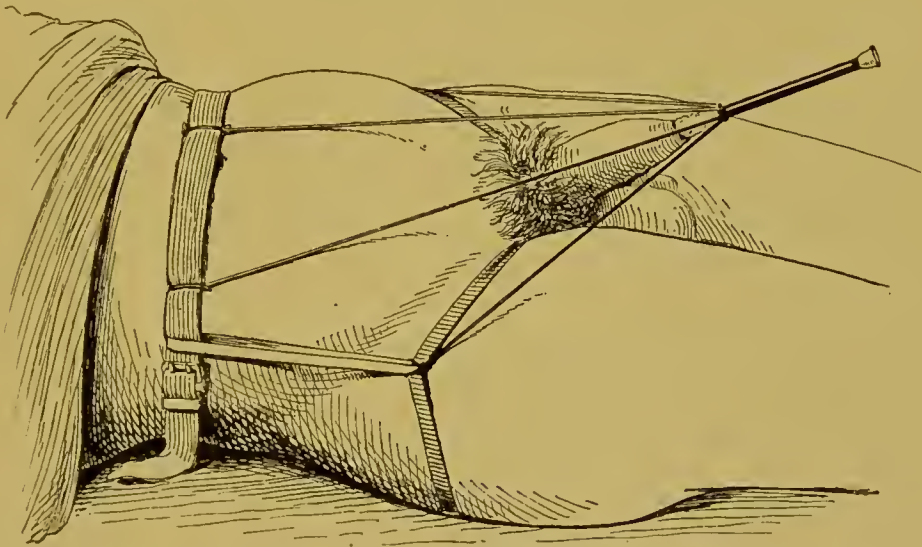


FIG. 68.—A METHOD OF TYING A CATHETER INTO THE BLADDER. The sketch shows the arrangement of the tapes round the thighs and abdomen and that of the threads that secure the catheter to the tapes.

nally seem to have no effect on the bleeding and in any case where this is a severe symptom radical measures should be seriously considered. It will rarely be necessary to open the bladder above the pubes for this condition ; it may however be necessary if it be impossible to evacuate the clot as recommended above.

The simplest *method of tying a catheter into the bladder* is to wrap a narrow piece of strapping around the catheter about half an inch in front of the meatus, leaving an end long on each side. The instrument is then covered with boracic lint between the strapping and the meatus, and the lint is made to cover the glans penis, over which the prepuce is pulled forward, and then the ends of the strapping are applied on either side of the penis and kept in position by a narrow strip wound horizontally around the organ behind the corona. Care must be taken not to fasten this circular strip too tightly and, should it cause any inconvenience, the tension can be overcome by slitting it up on the dorsum. Another method is to fasten the instrument to the limbs

of a T-bandage by means of four threads but, as the bandage is apt to slip, this is not a safe method. A preferable plan is to fasten the catheter by means of four threads (see Fig. 68) to loops of tape passed around the thighs and secured to a firm abdominal bandage. Soft rubber catheters have been designed with expansile wings which project immediately the point of the instrument passes into the bladder and tend to prevent it slipping out; they are not sufficiently reliable however. In tying in a catheter it is very essential not to let it lie with its point too far in the bladder. The best way to ascertain this is to pass the catheter on until the urine flows freely and then to withdraw it slowly until the flow of urine just ceases; then the instrument is pushed back a quarter of an inch and tied in position. This will leave the eye lying just within the neck of the bladder.

The only other complication that need be referred to is the development of *calculi* in the post-prostatic pouch. These are essentially phosphatic in nature, are usually associated with cystitis, and cause immense trouble to the patient. The condition is extremely difficult to treat by litholopaxy, especially when the post-prostatic pouch is large, as it may be difficult to seize the calculus even with the patient in the Trendelenburg position, and small calculi or fragments may be easily overlooked. It is also very difficult to wash out the débris perfectly, as they not at all uncommonly lodge in pouches in the bladder wall, where they may form the nuclei of fresh stones. Moreover there is serious danger of doing grave injury to the enlarged prostate with the lithotrite or with the evacuating apparatus. The best method therefore, when other conditions are favourable, is to perform prostatectomy through a supra-pubic cystotomy wound; not only are the stones immediately and completely removed by doing this, but the post-prostatic pouch is got rid of, and the septic condition of the urine is thereby overcome, as the patient is enabled to empty his bladder completely, and there is no longer any residual urine, and therefore no likelihood of fresh deposit of phosphates. A supra-pubic lithotomy without enucleation may be preferred to lithotripsy when the organ is very large and the post-prostatic pouch is extensive. Here however there is a certain amount of risk of a permanent supra-pubic fistula, and moreover the operation is not unattended with risk in elderly subjects if the urine be septic.

CHAPTER XXXVI.A

CONGENITAL MALFORMATIONS OF THE URETHRA.

THESE conditions though of great importance are fortunately rare; the most important are hypospadias, epispadias and complete or partial occlusion of the urethra. Abnormal communications between the urethra and neighbouring structures, such as the rectum or the vagina, have already been mentioned (see p. 8).

CONGENITAL STRICTURES OF THE URETHRA.

Congenital strictures of the urethra are met with in various situations; for example the stricture may be at the external meatus, in the penile portion just behind the fossa navicularis, or close to the prostatic urethra, and it usually takes the form of a valvular fold or diaphragm. In the adult, the meatus will usually admit a No. 12 English bougie and in children of two or three years it should admit a No. 4 or 5; if it does not, it must be considered abnormally narrow. As the meatus is as narrow as any part of the canal, any instrument that can pass through the meatus should pass on into the bladder. Any constriction in the urinary passages should receive immediate attention as it exerts injurious backward pressure.

TREATMENT.—If there be a narrowing of the external meatus, a few drops of a 5% cocaine solution should be injected into the orifice and a fine tenotome or a canaliculus knife passed until it is well beyond the constriction; it is then made to cut downwards in the middle line until the meatus has been sufficiently enlarged to admit a full-sized instrument. If the incision be at all extensive, the cut edges of the mucous membrane are united by a stitch or two to the cutaneous surface, but when the narrowing is very slight the occasional passage of a No. 14 bougie¹ will prevent contraction during healing. In some cases a much more free incision has to be made and then steps must be taken to prevent subsequent contraction by covering the cut surfaces with epithelium. When the wound is too

¹ This need only be about two or three inches long.

extensive to be treated by stitching the mucous to the cutaneous surfaces this may be done by raising a small triangular flap from the frenum and interposing it between the cut lips of the meatus. The apex of the flap should be at the point of attachment of the frenum to the penis and the flap should be raised before the meatus is slit. The apex of the flap is then fastened to the distal end of the urethral mucous membrane with fine catgut and thus the cut surfaces are lined by skin, and contraction is avoided. Not only does an unduly small meatus exert injurious backward pressure but the patient will suffer severely should he contract any form of urethritis.

Congenital strictures further down the urethra must be treated on the same lines as for the acquired form (see Chap. XL.).

HYPOSPADIAS.

This condition is due to want of fusion of the lips of the uro-genital sinus which go to form the urethra and varies in degree from an unduly large meatus to a completely cleft urethra. It is noteworthy that this deformity, unlike the somewhat similar condition of epispadias, never extends into the bladder and incontinence of urine is therefore not one of its complications.

In hypospadias affecting the glans penis the inconvenience that the patient suffers may be so slight as to be almost unnoticeable, but it increases the further back the cleft extends. There are two troubles in connection with hypospadias. In the first place the urethral opening is always unduly narrow, sometimes extremely so. There is therefore a certain amount of back pressure from which serious results may follow; it is always essential in treatment to see that the orifice is made of full size. The second important point is that the penis is always curved downwards when the cleft in the urethra extends any distance backwards and this incurvation is greater the further back the cleft extends. Attempts to straighten the organ are resisted by a fibrous band corresponding to the remains of the uro-genital groove and lying in the position of the normal urethral roof. This incurvation produces much inconvenience, as the urine is projected against the down-curved organ, the stream is broken up and the patient is constantly wetted; in children this often gives rise to troublesome eczema in addition to the offensive ammoniacal decomposition of the urine upon the clothes. When the incurvation of the organ is not extreme, the trouble may be avoided by lifting up the glans when passing water, and holding it out of the way of the urinary stream, but in marked cases this is not possible. When the urethral orifice is situated further back than the glans, coitus is practically impossible, as proper erection is prevented by the incurvation. When the cleft extends still further back and is associated with a cleft scrotum, the condition closely resembles hermaphroditism and the rudimentary organ is quite useless.

From the point of view of treatment the cases met with in practice may be divided into three groups: 1. Those in which the fissure is limited to the glans; 2. Those in which the cleft is in the penile portion and the orifice of the urethra opens anteriorly to the scrotum; and 3. Those in which the scrotum is cleft and the urine issues from an opening in the perineum.

TREATMENT.—Treatment is only of avail when the urethral orifice is in front of the scrotum. When the latter is cleft and the urine passes through a perineal opening the chances of repairing the urethra are very slight and, moreover, operative interference is not called for so urgently as the trouble in micturition is not marked. Therefore it would seem advisable not to interfere in cases of complete hypospadias.

When the hypospadias simply consists of an unduly large meatus it is often unnecessary to interfere at all. The only point of importance is to make sure that there is no constriction at the orifice of the urethra; should one exist it must be slit up in the manner already described for stricture of the meatus (see p. 347).

When however the condition is one either of complete hypospadias glandis or of a cleft urethra anywhere between the glans and the scrotum, it is necessary to attempt to repair the urethral canal, and the first question is as to the age at which this should be done. The best age would seem to be before puberty, namely from six to twelve years of age; by that time the patient is amenable to discipline and there is also plenty of time for the genital organs to develop after the operation, and moreover there is not so much likelihood of trouble occurring from erection of the organ as there is when adult life is reached. Erections are very apt to be fatal to the success of any operation.

Three points have to be attended to in treating a case of hypospadias. In the first place the curvature of the penis must be remedied; in the second, the natural orifice of the urethra must be made of normal size; and lastly, a fresh urethra must be made from this orifice to the end of the glans. The only satisfactory way of fulfilling these indications is to operate in stages, and generally four or five operations are necessary before the case is complete. The first operation should always be directed to remedying the incurvation of the penis and at the same time a new urethral canal may be made in the glans. The second stage will consist in making a new urethra between the meatus and the newly-formed urethra in the glans penis, whilst the final stages of the operation will be directed to enlarging the old meatus sufficiently and joining the various portions of the new urethral tube. Further smaller operations may be necessary to remedy failures in any particular situation.

The treatment takes a long time, and it is well to allow a considerable interval to elapse between each stage, so that it is hardly safe to reckon on finishing with a case of hypospadias under a year at least. The longest interval should be allowed to elapse between straightening the penis and

the subsequent procedures, and the formation of a new urethra should not be undertaken until it is evident that there is no tendency to recurrence of the incurvation. All cicatrices tend to contract for some considerable time, and to form a fresh urethra over a penis which subsequently becomes incurved from contraction would be to render the whole operation futile. Some surgeons allow as much as two years to elapse between the operation for remedying the incurvation and the subsequent procedures; and at the very least six months are necessary.

To remedy the incurvation of the penis (see Fig. 69) either subcutaneous division or open incision may be employed; the latter method seems preferable and in bad cases is the only possible one. The glans is seized and pulled upwards, so that the penis is put upon the stretch, and a transverse incision is made through the centre of the band binding down the organ deeply

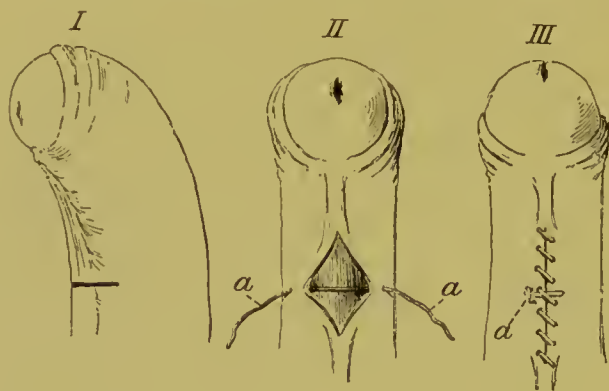


FIG. 69.—METHOD OF RECTIFYING THE INCURVATION OF THE PENIS IN HYPOSPADIAS. I. Transverse incision across the fibrous band holding down the organ. II. Conversion of this incision into a lozenge-shaped space after free division of the band and forcible straightening of the organ; *a* is the first suture introduced, and brings the horizontal angles of the lozenge together. III. The incision completely sutured.

enough to divide it completely. This band lies beneath the upper surface of the urethra and extends into and involves the septum between the corpora cavernosa. All processes must be freely divided, and the sheath of the corpora cavernosa will generally be found to be contracted and must be divided to the requisite extent. When the band has been fully divided the penis can be straightened and a diamond-shaped defect will be left in place of the transverse incision. Should it be impossible to straighten the organ fully by this means, the best plan is to dissect out the band altogether as it is essential that there shall be no obstruction to complete extension of the organ; it is necessary to allow for erection as well as to remedy the curvature in the flaccid condition.

After straightening has been thoroughly effected, the diamond-shaped space is closed by sutures so as to convert the transverse incision into a longitudinal one, and provision is made for preventing recurrence of the incurvation during healing. This is the most difficult part of the treatment. A good plan is to fasten the organ to the abdominal wall in the first place by a suture passed through the prepuce, but, as this cannot be kept in for

any length of time, a piece of gauze may be fastened over the glans with collodion when the wound has healed, and the two ends similarly fixed to the skin of the abdomen so as to make the organ lie flat upon the abdominal wall. The gauze will need to be renewed every three days or oftener, and, provided that the skin be not irritated by the collodion, the plan may be persevered with for a considerable time, in fact until all tendency to contraction has ceased; the organ should be fully stretched each time the dressing is renewed.

Formation of a new urethra in the glans.—The next step is to fashion a new urethra in the glans penis. Many surgeons do this simultaneously with the foregoing operation, but we prefer to leave it for a time, so as to be sure of having an intact organ to deal with when carrying out the after-treatment for remedying the incurvation. The second step therefore in the procedure that we adopt is to make a new urethra in the glans, and to enlarge the already existing urethral orifice if that be too small.

In a complete hypospadias the glans is cleft and the urethra is represented by a broad depression. It is generally easy to make a fresh urethra by carrying an incision into the substance of the glans on each side from the edge of this groove for about a quarter of an inch (see Fig. 70); after they are made it will be found that the epithelial-covered surface can be pressed into the glans by a rod laid into the groove, and the soft parts approximated below it. The extreme edge of the furrow in the glans is then pared on either side, and the pared edges are brought together over a solid glass rod and united by mattress sutures.¹ This provides a canal lined with mucous membrane in the natural position of the urethra. The rod is retained in position until healing is complete. Union generally takes place readily, as urine does not pass over the raw surface; no narrowing will occur because the new urethra is covered by mucous membrane, and the passage of bougies is therefore unnecessary.



FIG. 70.—RESTORATION OF THE URETHRA IN THE GLANS PENIS IN A CASE OF HYPOSPADIAS. I. The upper pair of dotted lines indicates the incisions into the substance of the glans. The lower pair are for rendering the edges raw, so that they may be approximated, as in II.

¹ This plan may not succeed if the groove on the under surface of the glans be very shallow, and it has been suggested as an alternative that the termination of the urethra should be dissected up and, when it has been sufficiently freed, a trochar and cannula of suitable size should be thrust through the glans from the apex to the corona so as to make a canal through which the urethra is pulled, its edges being stitched to the edges of the opening at the apex of the glans. This is theoretically a very fascinating procedure, but practically the objection is that the urethra is scarcely ever long enough for this purpose, and that, if the plan be feasible, there will probably be a recurrence of the incurvation due to the pull of the short urethra. A better plan under the circumstances is to fashion the floor of the new urethra from the prepuce which may be transferred from the dorsal to the under surface (see p. 354).

At the same time if the urethral orifice be found too narrow it may be slit up with a tenotomy knife until it will admit a full-sized instrument, and then the cut edges of the mucous membrane and the skin are stitched together. This gives a sufficiently large opening without any risk of stricture.

Restoration of the penile urethra.—After having allowed sufficient time to elapse for these wounds to heal, and for the recurvation of the penis to be completely overcome, the closure of the urethra between the natural orifice and the glans penis may be proceeded with. This is best done by one of the operations known as Duplay's but Thiersch's method for the cure of epispadias (see p. 356) may also be employed. In *Duplay's* operation a vertical incision is made on each side of the cleft, extending from the glans penis backwards to the level of the urethral orifice. These incisions should be at such a distance from one another that, when the two flaps are dissected up and folded over, they can be made to meet in the middle line without any tension. At either end small transverse incisions are carried in towards but not actually to the middle line, so as to enable the flaps to be raised inwards. The incisions are carried right down to the capsule of the corpora cavernosa, and the flaps are dissected up on each side sufficiently to enable them to be folded over and united to one another in the middle line over a glass rod or suitable bougie; they thus form a urethral canal which is lined by mucous membrane the whole way. The flaps are united by a few fine catgut sutures, and their raw outer surface is then covered by sliding in skin flaps from each side. This is done by carrying incisions horizontally outwards from each end of the vertical ones, and dissecting up the flaps thus formed. These flaps can then be pulled in to meet in the middle line where they are united by quill or button sutures.

The wound is dressed with strips of gauze fixed on by collodion, and these need not be disturbed unless they become soiled with urine. If the dressing should be soiled, it should be thoroughly wetted with boracic lotion after micturition and then changed as frequently as may be necessary; it should not be allowed to remain on the wound if it becomes contaminated with putrefying urine. The glass rod should be left in position for the first three or four days at any rate, when it may be removed and need not be replaced. No instrument should be passed until healing is complete.

The objection to this method is that there is often much tension on the skin flaps which cover the outside of the new urethra, and union is apt to give way, so that granulation and cicatrization occur and the new urethra is considerably pressed upon. The tension on the flaps may be remedied by making a longitudinal incision through the skin of the penis in the middle line of the dorsum. This incision will generally heal readily enough spontaneously, or if not it may be covered with a skin-graft. Any slight contraction that occurs in it will help to prevent incurvation.

This method is not applicable under all circumstances, partly because of the tension mentioned above, partly also because occasionally the groove

is not wide enough to enable the flaps to be brought together in the middle line, and therefore an important modification of the operation has been introduced by Duplay himself which is as follows (see Fig. 71):

Experience has shown that it is not necessary for the whole of the new urethra to be lined with epithelium in the first instance, as any raw surface on the flap will become covered with epithelium as healing takes place. Duplay therefore makes vertical incisions nearer to the middle line than in the foregoing operation (see Fig. 71, I.), and dissects up the flaps very slightly indeed. Lateral incisions are then carried outwards from the end of each of the vertical ones, and lateral flaps of skin are

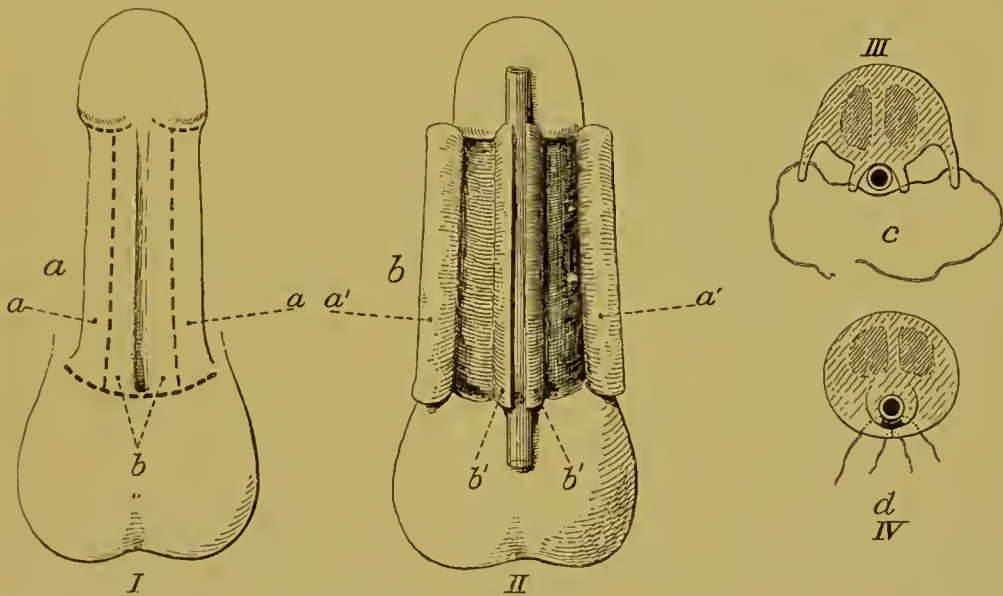


FIG. 71.—DUPLAY'S OPERATION FOR HYPOSPADIAS. I. Incisions for raising the flaps. II. The flaps raised. III. The method of inserting the sutures so that both flaps shall be secured and no buried stitches shall be used. IV. The flaps and sutures in position. There is a gap where the deeper flaps fail to meet; this is covered over by the approximation of the skin or superficial flaps.

dissected up (see Fig. 71, II.); these are similar to those already described except that they are larger, since the vertical incisions are nearer to the middle line and therefore the flaps are broader, and there is not the same tension and likelihood of giving way. The method of inserting the stitches is shown in Fig. 71, III. and IV. The needle is carried first through the skin flap, then it picks up the edge of the flap of mucous membrane, passes over the glass or metal rod laid in the new urethra, and takes up the structures on the opposite side in the reverse order, being finally brought out on the surface. The material for suture should be fine silkworm gut or horsehair, and the stitches should be inserted about a quarter of an inch apart; the edges of the skin are united by fine horse-hair in the intervals. In this plan no buried sutures are used, and healing generally takes place without trouble. It will thus be seen that only two-thirds of the new urethra are covered with mucous membrane in the first instance,

and that the portion forming its floor is furnished by the raw surface of the skin flaps.

Cyanide dressings are applied and secured in place with collodion, and the penis is fastened flat upon the abdomen. The glass rod is left in position for the first four or five days, when it is removed, thoroughly sterilised and re-introduced. It must be kept in position until the healing is complete, being changed for cleaning purposes every day or two. The sutures are removed in a week or ten days and, when healing is complete, a bougie must be passed at intervals to prevent contraction.

Closure of the gaps left in the urethra.—The final stage is the closure of the gap left between the new urethra and the old urethral orifice behind,

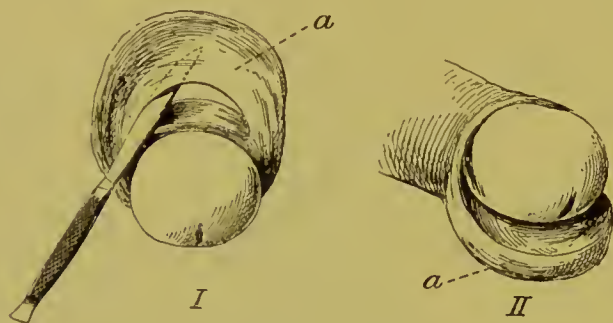


FIG. 72.—METHOD OF UTILISING THE PREPUCE IN PLASTIC OPERATIONS UPON HYPOSPADIAS. I. The preputial hood *a* is put on the stretch and transfixed. The glans penis can then be passed through the transfixion aperture, when it occupies the position shown in II.

while in front the penile and meatal portions of the urethra require to be joined. For the latter the redundant hood of prepuce which is always present in cases of hypospadias may be usefully employed. The aperture between the two portions of the urethra is made raw, and the under surface of the glans penis is also rawed to a certain extent, and then the prepuce is put upon the stretch, and a knife is made to transfix it in the manner shown in Fig. 72, I., and to separate it from the penis for about half its extent. This leaves a large slit between the prepuce and the glans through which the latter can be passed, so that the hood of prepuce is now brought down to the under surface of the organ (see Fig. 72, II.), and lies over the surface previously made raw. A few horsehair sutures are then made to unite the cut edge of the prepuce to the aperture in the urethra, and the preputial flap is also fastened to the raw area on the under surface of the glans.

Before proceeding to the final stage, namely, the closure of the gap between the original urethral orifice and the newly-formed urethra, sufficient time must be allowed to elapse for any contraction to have reached its maximum and in the meanwhile any defects in the previous plastic operations may be remedied by paring the edges and suturing them. It is essential that all the other stages of the operation should be perfected before the urine is allowed to pass over the newly-formed urethra. To complete the

operation a full-sized catheter is passed from the external meatus into the bladder and tied in position (see p. 345). The edges of the gap between the old and the new urethra are then pared, and the raw surfaces are brought together over the catheter by a few points of suture. The catheter is kept in for about six days and all the urine is allowed to drain continuously through it by means of an india-rubber tube carried into a suitable receptacle; at the end of that time it is withdrawn and the patient is allowed to micturate naturally.

The operation done in three stages in this manner is very successful on the whole and gives good functional results. Several causes of failure however have to be carefully guarded against. In the first stage there may be severe and persistent oozing if the corpora cavernosa be injured, and union will be interfered with unless all hæmorrhage is arrested before the sutures are put in. In the second stage partial defects of union such as are met with after operations for cleft palate may be encountered but these need not discourage the surgeon, as it is comparatively easy to remedy them by paring the edges and suturing them as long as no urine passes through the canal. The worst difficulty is generally met with in the final stage when the two urethras are connected up, and the failure here may be so persistent that it may become advisable to make a button-hole incision into the perineum through which a catheter is passed into the bladder so as to divert the urine until union is complete, when the catheter is left out and the perineal opening closes readily.

Some dilatation at the junction of the new with the old urethra may be noted after the operation and urine may collect there during micturition and escape afterwards. This however is easily remedied by pressing with the finger over the dilated spot so as to squeeze out any remaining drops. The condition tends to improve as time elapses.¹

EPISPADIAS.

This deformity is the reverse of hypospadias and in it the upper wall of the urethra is deficient. It is much rarer than hypospadias and, although the cleft may be limited to the anterior part of the urethra, it more commonly extends into the neck of the bladder and is a common complication of ectopia vesicæ (see p. 264). In the complete form of the affection true incontinence of urine is present but, when the cleft is limited to the anterior part of the urethra, the patient may retain complete control. The penis

¹ In the *British Medical Journal* of Nov. 17th, 1900, Dr. Hamilton Russell of Melbourne describes an original operation for these cases for which he claims excellent results. We have not yet had an opportunity of testing the method, but the description given by Dr. Russell indicates considerable improvements in certain points, especially in the formation of the anterior part of the urethra, and the operation is certainly one which should be considered in deciding as to the best method by which the deformity may be remedied. Those who are interested in the matter may consult Dr. Russell's original paper: it will also be found quoted in Jacobson's *Operations of Surgery*.

is usually curved upwards by the agency of fibrous bands passing from the symphysis pubis to the middle line of the dorsum of the penis and the patient suffers from even more disability than in the corresponding condition of hypospadias.

TREATMENT.—This very closely resembles that for hypospadias. The slighter forms of the deformity, in which the urethra is cleft only where it passes through the glans, do not call for operative interference. In the more extensive cases, where the penile urethra is affected but the neck of the bladder is intact, operations upon lines similar to those for hypospadias may be practised. When there is also extroversion of the bladder the

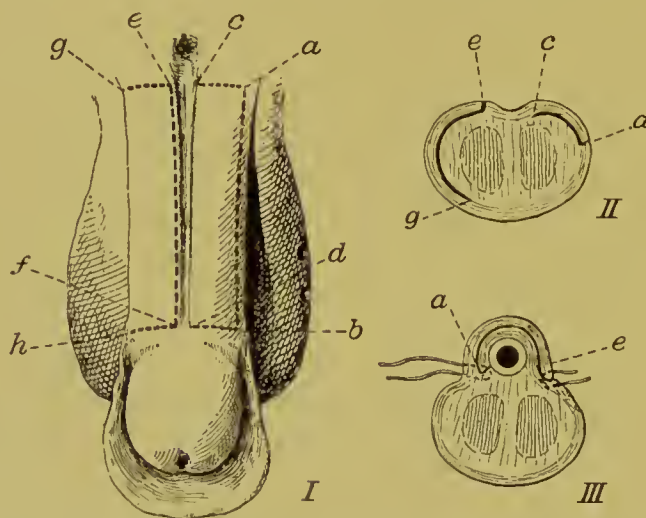


FIG. 73.—THIERSCH'S OPERATION FOR EPISPADIAS. I. Incisions for raising two flaps *abdc* and *efhg*. II. The direction in which the flaps are raised; *ac* represents the flap *abdc* and *eg* the flap *efhg*. III. Method of reflecting and suturing the flaps. The edge *a* of the flap *ac* is sutured to the point *e* in II., while the edge *e* of the flap *eg* is sutured to the point *a* in II. This diagram also shows how buried sutures are avoided, and yet the flaps are properly secured.

treatment of the cleft urethra must be delayed until the ectopia has been remedied. In all cases the operation is done in stages as is that for hypospadias, the organ being straightened in the first instance, the urethral canal restored in the next place, whilst finally this is united to the opening at the root of the penis.

Straightening the re-curved penis is done exactly as for hypospadias (see p. 350) but in this case the organ requires to be fastened down during healing and the best plan is probably to employ the wire frame recommended for use in retained testis (see Chap. XLV.) and to fasten the organ to it by means of a stitch through the frenum. This apparatus can be worn even when the patient gets about, and the movements of the limbs do not in any way interfere with the wound. It is a far better plan than stitching the organ to the skin of the thigh.

Thiersch's method.—The restoration of the penile urethra is best done by the method known as that of Thiersch, which differs somewhat from that described for hypospadias. The method will be evident from the diagrams

(see Fig. 73). Two flaps are fashioned, one on either side of the urethral groove, by means of vertical incisions parallel to its margins. On the one side transverse incisions are carried inwards towards the middle line, whilst on the other they are carried outwards just below the glans penis and just above the orifice into the bladder. The two flaps thus fashioned are dissected up and the one that is raised towards the middle line is turned over so that its cutaneous surface forms the roof of the urethral canal and is fastened to the raw surface from which the other flap has been raised (see Fig. 73, II.). This second flap, which should be considerably larger than the first, is then pulled in over the latter so that the two raw surfaces are in apposition; its cutaneous surface therefore forms the cutaneous covering of the dorsum of the penis. The diagram (see Fig. 73, III.) will serve to show how the sutures are inserted; it is important not

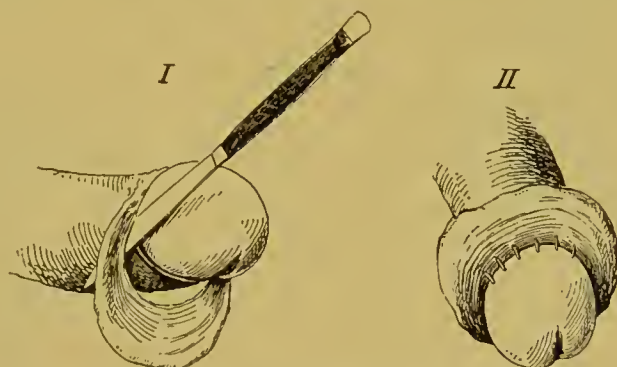


FIG. 74.—METHOD OF UTILISING THE PREPUCE IN PLASTIC OPERATIONS UPON EPISPADIAS. This is the exact reverse of the steps of the operation shown in Fig. 72.

to bury any of them, as the asepticity of the wound cannot be guaranteed; they are therefore so arranged that they are tied outside and can be removed easily. The urethra is formed over a glass rod of suitable size as in hypospadias. At the same operation the small triangular interval between the urethra in the glans and the newly-formed penile one is closed by utilising the prepuce in a manner very similar to that described for hypospadias (see Fig. 74). The urethra in the glans penis may be restored at the preliminary operation of straightening the organ.

The final stage consists in connecting the proximal end of the new urethra with the bladder, and for this purpose Thiersch uses flaps fashioned as shown in Fig. 75. The edges of the defect are pared and the first flap is turned over so as to lie in the triangular space, to which it is stitched. The second flap is then bent downwards so as to cover the raw outer surface of the first and is fixed in position. The raw surfaces from which the flaps are raised may be allowed to heal by granulation or can be grafted. The difficulty about this operation is to secure union if urine be allowed to pass along the new urethra before healing is complete, and the best plan is therefore to make a button-hole opening in the perineum, to insert a tube through it into the bladder and to drain the organ in this manner for

the first five or six days. The tube is left out when union of the flaps is complete and the perineal opening is allowed to close.

The chief objection to this part of Thiersch's operation is that the reflected flap carries with it hairs which grow down into the urethra and may cause trouble from the deposition of phosphatic concretions upon them.

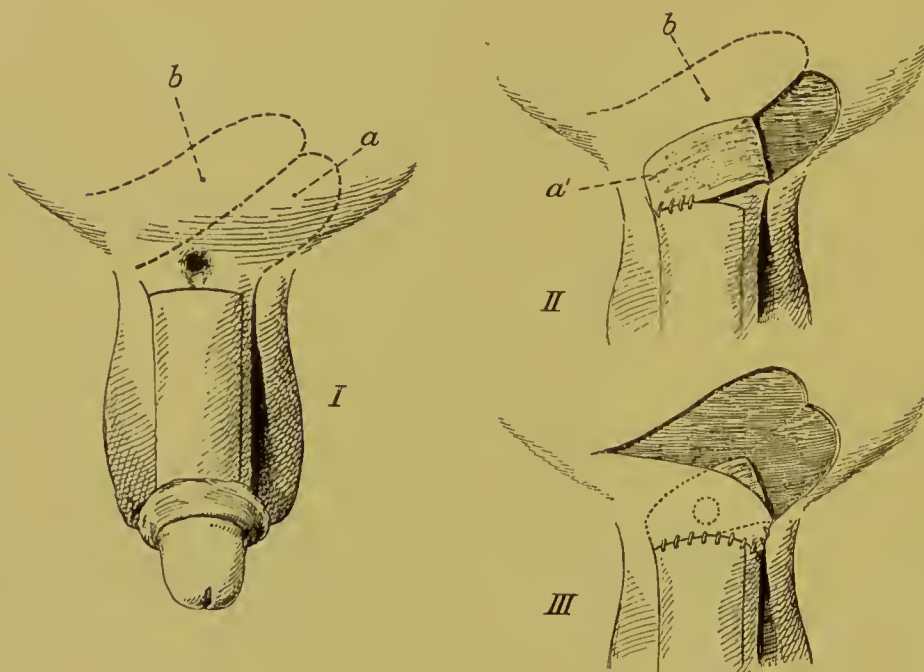


FIG. 75.—THIERSCH'S OPERATION FOR EPISPADIAS. This shows the final stage, in which the new urethra is connected with the orifice at the neck of the bladder. I. Shows the two flaps *a* and *b* marked out. In II. the flap *a* is reflected and sutured to the pared edge of the new urethra, so that its raw surface is outside. In III. this is covered in by the flap *b* which has its cutaneous surface outside.

The method may be advantageously modified by sliding a flap in from one side with its raw surface looking downwards instead of using the superimposed flaps mentioned above. The deeper surface of this flap, which should be of large size, naturally granulates and contracts, but if it be made large enough in the first instance, no constriction of any consequence is produced and indeed any slight narrowing that may occur is probably beneficial to the patient in allowing him to obtain some sort of control over the urine in the bladder and in preventing the constant dribbling which is such a distressing feature of *ectopia vesicæ*.

CHAPTER XXXVII.

TRAUMATIC AFFECTIONS OF THE URETHRA.

DAMAGE done to the urethra by the passage of instruments is not included here; it will be more appropriately described with stricture of the urethra (see Chap. XL.).

From its protected position the urethra is but little exposed to injury by penetrating wounds. The common injuries take the form of kicks or falls astride and give rise to contusions or rupture of the urethra.

PUNCTURED AND INCISED WOUNDS.

Punctured wounds rarely call for surgical interference. Healing is rapid and satisfactory, and the cicatrix is small and does not give rise to trouble from subsequent contraction.

Incised wounds are rare and, if the incision be parallel to the long axis of the urethra, the treatment is simple, as the wound does not gape; it is merely necessary to see that the skin wound is sufficiently free for drainage. If the incision be clean, one or two catgut stitches should be put in the urethra to keep the edges together but should not penetrate the mucous membrane. Healing is rapid, and there is little tendency to subsequent stricture, as the cicatrix is in the long axis of the canal. The patient is allowed to micturate naturally.

If however the wound cross the long axis of the urethra transversely, or even obliquely, a stricture will inevitably result if cicatrization be allowed to occur without perfect coaptation of the cut edges, and the treatment must be directed to securing this. A full-sized gum-elastic catheter should be first passed into the bladder, after which the urethra is well exposed by a free longitudinal incision through the soft parts so as to lay bare the whole extent of the urethral injury. The cut edges of the urethra are then accurately united with fine catgut, the ends of the urethra being freed a little if necessary to allow the edges to come together without tension. The sutures should be passed in

Lembert's fashion, avoiding the mucous membrane, and the soft parts around the urethra, and also the skin, should be sutured completely except at one spot which is kept open by a strand of iodoformed gauze to allow for the escape of urine. The catheter should be left in for 24 hours, when it is withdrawn and the patient is allowed to micturate naturally. With accurate suturing there is little risk of the wound being burst open during micturition and, if no catheter be used, there is no risk of the wound being damaged and urethritis is also avoided. It is well to administer bromide of potassium (grs. 25) and chloral (grs. 10) every evening at bedtime in order to prevent erections which might interfere with union. The cicatrix is small if the suture has been accurate and there is little tendency to contraction. It is well nevertheless to pass a bougie, at any rate for the first two years, at intervals gradually increasing in length from a fortnight up to six months or more, so as to make sure that no stricture occurs. If it does, the case becomes one of stricture of the urethra (see Chap. XL.).

CONTUSIONS AND RUPTURES.

Contusions of the urethra most commonly follow falls astride of an object such as a rail or a beam. They may also be due to kicks or direct blows upon the perineum and very commonly complicate fracture of the pelvis. More rarely they are the result of slight violence, as for example a sudden erection in a patient suffering from chordee. In these cases the injury occurs only in the penile portion and will be referred to in connection with gonorrhœa (see Chap. XXXIX.).

The injury to the urethra usually occurs near the junction of the bulbous with the membranous portion. When the rupture complicates a fracture of the pelvis the membranous and sometimes, though rarely, the prostatic urethra are lacerated. In falls astride the injury is produced by crushing the urethra against the side of the pubic arch in the majority of cases, the patient striking the obstacle somewhat sideways; in others however the membranous urethra may be torn across without any actual pressure against the bone.

The degree of injury varies. The first structure to be damaged is the spongy tissue outside the mucous and submucous coats, and a large diffuse hæmatoma may occur in this structure. In the more severe injuries however the submucous tissue is damaged and the mucous membrane is torn. In the most severe form of injury the urethra is torn completely across and this is most likely to happen when the injury occurs in the membranous portion. The chief dangers of these injuries are retention and extravasation of urine.

SYMPTOMS.—When the urethral mucous membrane is intact, the main symptoms are a hæmatoma in the perineum accompanied by a certain amount of pain. If the hæmatoma be large, its pressure upon

the urethra may interfere with micturition. In the majority of cases, however, the mucous membrane is lacerated, and in these cases there will be in addition an escape of blood from the meatus varying in amount according to the site and extent of the injury. The escape of blood occurs independently of micturition and under these circumstances is pathognomonic of a ruptured urethra. When the urethra is torn, the perineal swelling is generally large, and attempts at micturition are accompanied by a sharp cutting pain in the perineum and an increase of the existing swelling owing to extravasation of urine. The act of micturition is always difficult; when the urethra is completely divided it is quite impossible and acute retention supervenes.

The course taken by the case varies with the seat and degree of injury. When there is a mere contusion of the urethral mucous membrane, there is usually little trouble beyond some retention of urine. When however the urethral wall has been torn, there is always the risk of septic complications and, when the extent of the laceration is considerable, these complications are practically certain to occur. The blood escaping down the urethra furnishes a nidus whence bacteria spread rapidly to the seat of injury where they flourish in the extravasated blood and lead to septic complications. Another way in which septic infection may occur is by the introduction of an instrument; this is still more certain if a catheter be tied in. Under these conditions septic complications are almost inevitable, as it is impossible to tie in a catheter and at the same time to prevent the spread of infection to the urethral wound.

When the mucous membrane has been torn, the most serious complication is extravasation of urine. When the patient attempts to micturate, urine at once passes through the gap in the urethral mucous membrane into the tissues around and, as infection quickly occurs, symptoms of acute septic urinary infiltration arise. When the condition of affairs is such that the urine does not leave the urethra in any quantity, its escape nevertheless facilitates the onset of sepsis, and, when the tissues are softening under the septic process, the urine easily finds its way into the soft parts. This constitutes the so-called "late" extravasation of urine. After recovery a traumatic stricture is left which is more difficult to treat than the ordinary stricture resulting from disease.

TREATMENT. (a) **Of recent cases.**—When a patient has ruptured his urethra, he generally experiences a desire to micturate immediately and, should the surgeon see a case of pelvic injury immediately after its occurrence, he should always caution the patient not on any account to attempt to pass water until the condition of the urethra has been ascertained. Frequently however the patient has already made the attempt, and there is probably actual extravasation of urine before the surgeon has charge of the case. The diagnosis of the injury is generally easy, as the blood flowing from the meatus under these circumstances renders it quite evident that not only has the urethral mucous membrane been torn but that the submucous

and spongy tissues have also been damaged. It is important however to ascertain the precise condition of affairs in the urethra, and this requires to be done immediately, even when the case is one of fracture of the pelvis; the preliminary treatment of the rupture of the urethra—*i.e.* the means of avoiding extravasation of urine—must be adopted even before that of the fracture of the pelvis.

The condition of the urethra is ascertained by passing a scrupulously sterilised gum-elastic catheter with all the precautions as to disinfection already mentioned (see p. 336). The blood should be expressed as completely as possible from the urethra before the instrument is passed. It is best not to use the ordinary soft black catheter as there is no command over the direction in which its point goes and it will give little information; a gum-elastic instrument upon a stylet bent to the ordinary urethral curve is a better instrument. Should the surgeon succeed in passing the instrument into the bladder—and in order to do this successfully he must take care to keep the point well in contact with the roof all the way—he at once draws off the urine, ties in the instrument and then the appropriate treatment for any other injury present may be proceeded with. Should the attempt to pass the catheter be unsuccessful, attention must be paid to evacuating the contents of the bladder before anything further is done.

When the bladder is distended, some surgeons prefer to aspirate it above the pubes at once. This is a method which is quite legitimate when the surgeon is not prepared to proceed immediately to repair the urethra or when the patient is so collapsed as to be unable to stand operation. It is not advisable as a routine method however although some surgeons advocate not interfering with the urethra at all but prefer to aspirate the bladder above the pubes at regular intervals for several days so as to allow the urethra to heal. This plan we do not advise.

Various views are taken as to the right line of treatment. Some say that, when a catheter can be passed easily, no operative interference should be practised, an instrument being merely passed at regular intervals to draw off the urine. They further advise that, when catheterisation is difficult but still possible, an instrument should be tied in for some days, and finally that, when catheterisation is impossible, external urethrotomy should be performed.

As we have already pointed out, serious consequences may arise from septic infection of the clot effused into and around the urethral walls quite apart from the trouble due to extravasation of urine, and mere evacuation of the urine does not therefore meet the requirements of the case. It is also important to remember that passing a catheter is one of the most potent means of infecting a wound in the urethra and that, when instruments are passed repeatedly, septic material is almost inevitably introduced at some time or other and will probably lead to the phlegmonous inflammation it is so desirable to avoid. We are however of opinion that, if the injury to the urethra be only slight and if there be no difficulty in passing a catheter in

the first instance, the proper line of treatment is to evacuate the urine by passing an instrument at intervals of four or six hours and to continue this for three or four days before the patient is allowed to micturate spontaneously. In doing this it is essential that every precaution with regard to the disinfection (see p. 336) should be scrupulously employed. Moreover, when blood escapes from the urethra bacteria easily spread up along it and infection may therefore occur quite apart from the passage of the catheter; it is therefore most important that, as long as blood escapes from the meatus, the urethra should be treated just as any other wound and an antiseptic dressing should be applied to its orifice. The penis should also be put in a bag of antiseptic dressing and the meatus should be mopped out and disinfected (see p. 337) immediately before passing an instrument.

It is a very different question however with the cases referred to as being supposed to be suitable for tying in a catheter. This is a very inadvisable procedure, as it is practically impossible then to prevent sepsis spreading up the urethra along the instrument, however carefully the latter be disinfected or however clean the orifice of the urethra be kept. It has been found as a matter of experience that, of the three methods of treatment indicated above, the cases treated by tying in a catheter have presented the greatest mortality and this is only what might be expected, since the presence of the catheter, while it no doubt prevents extravasation of urine, cannot in any way prevent infection of the wound in the urethra and the tissues around. Moreover it is very likely to set up some irritability of the bladder and then, notwithstanding the continuous drainage, a few drops of urine are apt to be squeezed out alongside the catheter and to reach the wound; although the urine is not under any pressure and if aseptic will do no harm, it presents additional pabulum for bacteria and is therefore apt to increase the septic condition.

Hence in our opinion the surgeon has only two alternatives in the treatment of this affection, on the one hand the passage of a catheter at intervals and on the other external urethrotomy, and, considering the great value of the latter method, we see no reason for looking upon it as a last resort to be avoided save in exceptionally bad cases. According to Kauffmann the mortality in cases treated in this way is less than in any other, whilst its advantages are numerous. In the first place it opens up parts infiltrated with blood, so that free exit is given and the chances of septic infiltration are lessened. It may be urged as an objection to the operation that sepsis may occur in the wound and this is no doubt true as it is difficult to prevent infection in this situation, but it must be remembered that it is perhaps even more difficult to prevent infection of the tissues *per urethram* when a catheter is tied in, and that a subcutaneous infection is much more serious than when there is an open wound which may be freely drained and packed with antiseptic dressings. A second great

advantage of immediate urethrotomy is that the urethra can be repaired forthwith, so that more rapid and perfect healing is obtained, with a corresponding diminution in the extent of the subsequent stricture; indeed the stricture may be quite slight if the urethra be incompletely divided at the time of the accident and if the rent in it can be accurately sutured. This advantage is entirely lost if time be allowed to elapse and the wound be opened up after an interval on account of septic infection or urinary infiltration, as, apart from the sloughing which will probably have occurred in the tissues by this time and which renders the repair of the urethra impossible, there is the further difficulty that the ends of the urethra will be firmly imbedded in lymph and cannot be approximated and sutured as they can in a recent case. Moreover the ends of the urethra themselves are beginning to granulate and will be too soft to hold sutures.

For these reasons we strongly advise that, whenever there is evidence of marked injury to the urethral wall, and *a fortiori* when the symptoms point to the latter being torn partially or completely across, an immediate external urethrotomy should be performed and means taken to suture the rent in the urethra. The procedure is as follows:

The patient is anæsthetised and placed in the lithotomy position as soon as possible after the diagnosis has been made, and the perineum is shaved and disinfected in the usual manner. It is advisable not to empty the bladder immediately before the operation, as the presence of urine in the organ may be of considerable assistance in identifying the proximal end of the torn urethra (*vide infra*). A median incision is made from the root of the scrotum to within half an inch of the anal orifice and this is deepened in the middle line through the contused structures, and any bleeding points are clamped and ligatured. A full-sized metal bougie is now passed down the urethra until it reaches the seat of rupture, and its point is then carefully exposed in the perineal wound. It is essential to make the incisions in the soft parts as free as possible, and the various layers should be divided to the same extent, so that with good retraction it may be possible to see the state of matters clearly; a powerful electric light may be required.

The end of the instrument protruding through the torn urethra will at once lead to the identification of the distal end of the urethra, but the recognition of the proximal end is by no means always easy, as the parts are frequently much obscured by the infiltration of blood and possibly urine. The best plan in the first instance is to flush out the wound with warm salt solution. If the stream of fluid be projected fairly forcibly into the parts, the clots are turned out and the torn proximal end of the urethra may be identified, as it will probably project somewhat from the surrounding parts and may be seen floating in the lotion. If this manœuvre fails to identify the torn end at once, no time should be wasted in searching with a probe, but the assistant

should make pressure above the pubes over the bladder whilst the surgeon with a probe in his hand watches carefully for the escape of urine from the wound. As the urine escapes, its point of exit can be seen immediately and a probe may generally be introduced into the proximal end of the urethra without difficulty. The next step is to pass a full-sized, gum-elastic, blunt-ended catheter down through the meatus and, when the end emerges from the distal end of the urethra, the margins of the proximal end around the probe are seized and steadied in forceps and an attempt is made to insinuate the point of the catheter along the probe into the bladder. As soon as this has been effected the next procedure will be to approximate and suture the torn ends if possible. Usually the laceration is very irregular, and accurate suturing is impossible, but even if only two or three stitches can be inserted so as to bring the ends more or less into contact, the subsequent stricture may be considerably diminished. The sutures should be of the finest catgut and, although theoretically they should not include the mucous membrane, it is practically impossible to avoid doing this and it is not really a matter of much importance.

It may however be impossible to identify the proximal end of the urethra in this manner, especially when some days have been allowed to elapse between the date of injury and the operation. Under these circumstances, a supra-pubic cystotomy should be done (see p. 289), and an instrument passed from it down through the internal meatus so that its point emerges in the wound from the torn end of the proximal portion, which is thus recognised at once. A probe is now passed from the wound into the bladder along the instrument, and the surgeon will then try to insinuate a catheter in the manner described above from the meatus into the bladder. If this should fail, a procedure that we have tried with success may be adopted. A silk thread is tied tightly around the end of the instrument that has been passed from the cystotomy wound through the neck of the bladder, and the other end of it is threaded through the eye of the catheter which is passed down through the penile portion of the urethra. The first catheter is then withdrawn from the bladder through the supra-pubic opening, and the silk thread is drawn through the proximal portion of the urethra into the bladder and out through the cystotomy opening. Traction on the thread will then pull the catheter in the penile urethra towards the bladder, and gentle manipulations of its point will generally allow it to pass along the proximal urethra into that organ. The subsequent steps for the repair of the urethra are the same as before.

Should the urethra be only partially divided, the rent may be repaired accurately with fine catgut, and then the outlook is extremely good; very little stricture, if any, is likely to result.

It is best to leave the perineal wound open; a small drainage tube should be introduced through it into the vicinity of the rupture in the urethra so as to drain off any drops of urine that may escape, and the wound is lightly

packed with iodoformed gauze for a day or two. The sides of the wound fall together when the legs are in the horizontal position and tied together, and there is no necessity for stitches; indeed the insertion of sutures in this situation might lead to septic infiltration. A large antiseptic dressing is applied over the perineum, and the catheter is tied into the bladder (see p. 345), and is fitted with india-rubber tubing carried into a basin of boracic or carbolic lotion so as to insure continuous drainage. The practice of plugging the catheter and occasionally removing the plug for the purpose of emptying the bladder is not good, as urine is very apt to escape alongside the instrument and to complicate the case.

After-treatment.—The catheter is left undisturbed for about four days, when it is removed and a fresh, carefully-sterilised instrument is substituted. This should be of a somewhat smaller size; if a No. 12 instrument has been employed in the first instance, the next size introduced should be a No. 10, and this should be kept in position for two days, when it should be removed and another of the same size substituted. For the first fortnight it is well to keep a catheter constantly in the bladder, but after that time the patient may be allowed to micturate naturally, and an instrument should be passed every three days to prevent the recurrence of contraction, and this should be continued at gradually increasing intervals for a very considerable time in order to make sure that no stricture results. For this purpose Lister's bougies (see Fig. 87) should be used. In the first instance they should be passed twice a week for several weeks; the interval is then gradually increased if no contraction seems to be taking place. First a week, then two, three, four weeks and so on may be allowed to elapse, but the patient must be cautioned that for the rest of his life he is liable to stricture and that, should this once become well developed, it is very difficult to treat, and he must therefore never be allowed to pass from observation, and should have an instrument passed once in three months at least in order to be safe.

The external dressings should be changed every twelve hours, whilst the packing is renewed daily for a couple of days. The perineal drainage tube should be left undisturbed for four days, when it may be dispensed with. The perineal wound should not be syringed out, as this will only interfere with healing and cannot do good. The bowels should be kept confined for four or five days by suitable doses of laudanum, and should then be made to act by the administration of salines, so as to obtain liquid motions without straining. The external dressing should be removed just before defæcation, and a piece of gauze wet with 1-2000 sublimate solution should be kept over the perineal wound and then, as soon as the action is complete, the parts should be thoroughly washed with a 1-20 carbolic followed by a 1-2000 sublimate solution, the temporary gauze covering should be thrown away, the edges of the wound washed and the external dressing renewed. If sufficient care be taken in this manner the wound will remain aseptic, and it will generally heal in three or four weeks.

(b) **Of long-standing cases.**—When operative procedures have not been undertaken in the first instance, but are called for after the lapse of some time on account of the occurrence of sepsis, the procedure is practically the same. A catheter must be got into the bladder, either from the meatus or if necessary after supra-pubic cystotomy, but there is here no possibility of suturing the rent in the urethra. After the catheter has been tied in position all that can be done is to introduce a drainage tube down to the defect and pack the wound around it, carrying out the after-treatment as above described.

Extensive extravasation of urine may have occurred in the perineum by the time the patient is seen; the subject of extravasation of urine is dealt with separately (see Chap. XL.). When extravasation occurs very soon after the accident in these particular cases immediate perineal section is urgently called for, and a catheter must be tied into the bladder as recommended above, and the urethra repaired if possible. This will often be feasible in these cases as the extravasation is recent and the urine is probably not yet septic, and may be drained away freely through the perineal incision and septic infection thus avoided. Should extravasation of urine have existed for some time, and should symptoms of phlegmonous inflammation have set in, the case must be treated on the lines recommended for extravasation of urine (see Chap. XL.).

CHAPTER XXXVIII.

FOREIGN BODIES IN THE URETHRA : URETHRAL CALCULUS.

CALCULI are the foreign bodies that are most often met with in the urethra and their treatment does not present any marked points of difference from that of foreign bodies introduced through the meatus ; of the latter the most common are portions of catheter broken off from a faulty instrument, pencils, bonnet-pins, pieces of wood, etc. A broken-off portion of catheter generally lodges in the deep urethra, but the other foreign bodies of this type are met with in the front half of the penile portion. Urethral calculi may lodge in one of three principal situations. The commonest is the fossa navicularis, but they may be met with anywhere in the penile portion or at the junction of the membranous with the prostatic urethra. The stones are generally small rounded or ovoid bodies of renal origin. When they come from the bladder they are generally small portions detached from a larger stone and are sharp and irregular and may cause much trouble from impaction. Impaction of a calculus in the urethra is of common occurrence in children ; sudden retention of urine in a little boy is almost invariably due to this cause.

SYMPTOMS.—When a foreign body has been introduced into the urethra there is partial or complete interference with the passage of urine followed by urethritis and, if impaction has occurred in the penile portion, palpation will detect the foreign body. The history will render the nature of the case quite clear. In cases of impacted urethral calculus however there is sometimes difficulty. Generally the patient is seized with a sudden sharp pain on micturition, accompanied by stoppage of the flow and partial or complete retention ; if the urine can pass alongside the stone, the urinary stream is feeble and broken up. Profuse urethritis with blood-stained pus often occurs after impaction has lasted for a few hours and, when the calculus is sharp and is impacted in the urethral mucous membrane from the first, there may be oozing of blood from the meatus independently of micturition ; when this occurs

without a history of injury and without gonorrhoea it is very characteristic of an impacted stone. When the latter is situated in the fossa navicularis it can easily be felt and often seen through the meatus. When it is in the penile portion it can be grasped between the fingers, while, if it be situated lower down in the neighbourhood of the triangular ligament, pressure over it causes a sharp cutting pain.

It is always well to bear in mind that painful micturition followed by urethritis without any obvious cause, occurring either in children or in elderly subjects, is very likely to be due to this accident, and the largest-sized sound that the urethra will admit should always be passed, when the calculus can be detected easily. In passing a sound for diagnosis it is important not to use force, as otherwise the stone may be more firmly impacted, or laceration of the mucous membrane may be caused; the stone may also be driven downwards into some less accessible portion of the urethra.

TREATMENT.—It is essential to remove the foreign body as soon as possible, either along the urethra or, if necessary by an external incision. Severe urethritis, retention of urine, urethral abscess and extravasation may follow if the foreign body be allowed to remain. The exact steps of the treatment are determined by the size, nature, shape and situation of the body and the cases met with in practice may be divided into two large groups, namely, 1. Foreign bodies in the penile urethra, which in turn may be subdivided into (a) Those in which the foreign body is smooth and unimpacted and (b) Those in which the body is rough, pointed or impacted; 2. Foreign bodies in the deep urethra.

1. Of a foreign body in the penile urethra. (a) **When the body is smooth and unimpacted**, and especially when it is a stone, a useful plan is to direct the patient to compress the lips of the meatus firmly between the finger and thumb and then to attempt to micturate. The pressure is kept up for a few moments until the urethra becomes distended by the efforts to micturate and then, if the pressure be suddenly relaxed, the foreign body may be swept forcibly out from the distended urethra along with the urine. This manœuvre may be facilitated if it be done when the patient is sitting in a hot hip-bath. Should it fail, some other method must be adopted.

When the foreign body is lodged in the fossa navicularis it is only necessary to slit the orifice downwards sufficiently to enable the body to be squeezed or drawn out with forceps; the small incision is allowed to heal without treatment.

When the foreign body is further down the penile portion, it should be withdrawn if possible along the urethra. The patient should be fully anæsthetised and a urethroscopic tube (see Chap. XXXIX.) should be passed down to the situation of the foreign body, after taking the precaution to compress the urethra immediately behind the latter in order to

prevent the foreign body being driven deeper down. The object of the urethroscope is to see the exact size, shape and situation of the body and it may even be possible, when the object is small, to slip the end of the tube over one end of it, after which the body can be easily seized with forceps introduced through the tube, and removed. If this cannot be done, the urethroscopic tube should be withdrawn and a pair of urethral forceps should be passed down with closed blades until they touch the foreign body, which is prevented from slipping backwards by compressing the urethra behind it. When the foreign body is touched, the blades of the forceps are widely opened and attempts are made to gradually insinuate them between the body and the mucous membrane. If this is successful the foreign body is gently withdrawn. No attempt whatever should be made to push the body along the urethra towards the meatus by squeezing the parts from outside, as this is not likely to succeed and can only damage the mucous membrane.

No long time should be taken up in persisting with these efforts if they prove unsuccessful, as the mucous membrane is easily damaged even by the most careful manipulations with forceps. The case should at once be treated as if the body were impacted and the latter removed by incision.

(b) **When the body is rough, pointed or impacted** or when the above treatment fails, removal must be effected through a clean incision. The foreign body is readily defined and fixed in position by compressing the urethra behind it when it lies in the penile urethra and all that is then necessary is to stretch the parts firmly over it and to incise the corpus spongiosum and the urethra cleanly in the middle line down upon the foreign body, which can be seized and extracted immediately the edges of the incision are retracted. Should the body be a long one, such as a piece of slate pencil, the best plan is to cut down upon one end, which is then seized and the body withdrawn. It is in connection with objects such as these that the urethroscope may afford valuable information and may enable the surgeon to tell which end is impacted, in which case the impacted end should be cut down upon in preference to the other. Two or three fine catgut stitches should be made to close the urethra after the foreign body has been extracted, and the skin incision should also be sutured except at one point where a fine drainage-tube is inserted for a few days in case any leakage of urine should occur. The patient may be allowed to micturate spontaneously.

Occasionally large-headed bonnet- or carpet-pins are introduced into the urethra and there is a very simple and satisfactory method of getting them out without doing more than a minimum amount of damage to the urethra and without any cutting operation. These bodies are always introduced into the urethra head foremost and the head of the pin can generally be felt in the penile urethra. This is seized and fixed in position with the fingers whilst the penis is stretched and then firmly dorsi-flexed so as to thrust

the point of the pin through the urethral wall and skin on the under surface of the penis (see Fig. 76, *a*). The point is now seized and the pin is drawn out as far as it will come, leaving only the head inside the urethra. The direction of the pin is now reversed by rotating the point downwards towards the anus, so as to make the pin lie now with its head directed towards the meatus when, by holding the point of the instrument, the head can be easily pushed along the urethra towards the meatus, through which it is protruded and withdrawn (see Fig. 76, *v.*).

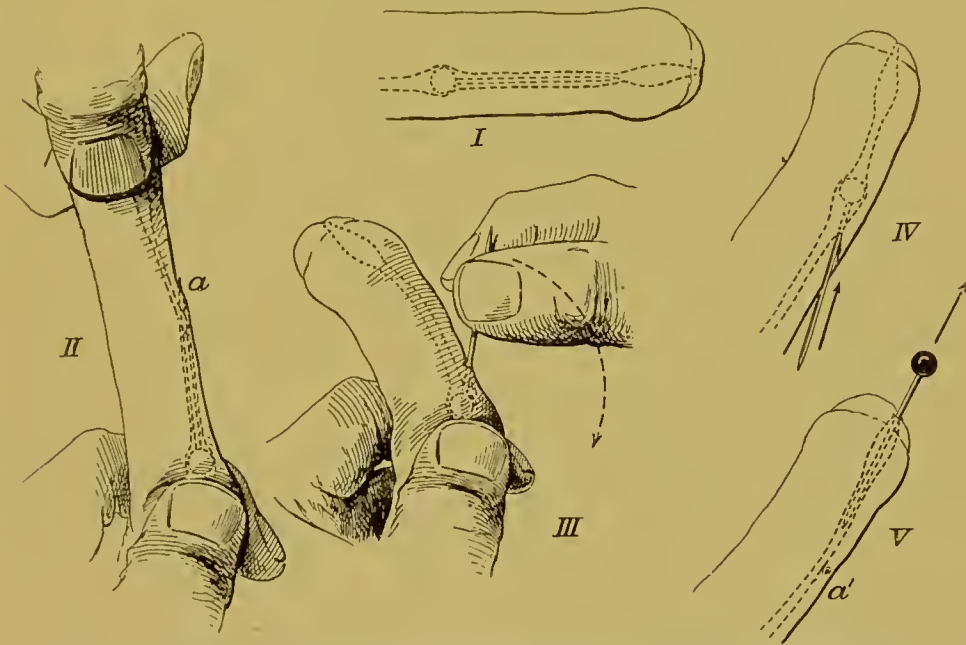


FIG. 76.—METHOD OF EXTRACTING A PIN FROM THE URETHRA. I. The pin is shown lying in the urethra with its head towards the bladder. The latter is fixed by the fingers and the penis is stretched and dorsi-flexed as shown in II. so that the point of the pin is made to protrude at *a*. This is seized and pulled out as far as it will come, and then, by carrying the point in the direction shown by the dotted arrow, the direction of the pin is altered and its head is made to look towards the meatus (IV), through which it can now be pushed (V), the pinhole at *a'* closing spontaneously.

2. Of foreign bodies in the deep urethra.—In this group of cases the treatment is identical whether the foreign body be impacted or not. The surgeon has to decide whether he will attempt to push the object into the bladder with a large sound and subsequently crush it with a lithotrite, or whether he will perform perineal section at once. Perineal section is to be recommended in most cases as it insures removal without any damage to the delicate prostatic urethra, which is almost certain to occur if any attempt be made to push the body forcibly into the bladder. The latter method is most uncertain even with a small smooth object, and if it be attempted the greatest care should be exercised and the surgeon must be ready to cut down at once if the attempt fail.

The cutting operation is very simple and takes the form of a median perineal section. A blunt-ended straight staff with a median groove (see Fig. 77) is passed down until it rests in contact with the foreign body and

its end is made prominent in the perineum by carrying the handle somewhat backwards towards the abdomen. The point is cut down upon in the perineum through an incision in the middle line, an inch to an inch and a half long, terminating about half an inch in front of the anus. The urethra is opened by a clean cut upon the end of the groove, the edges are seized with catch forceps and retracted, when the foreign body can generally be seen by the aid of a good light and may be grasped in forceps and removed without any damage to the urethral mucous membrane. The urethral incision may be either left to close spontaneously, or may be approximated by a few fine catgut sutures. We prefer the latter method and do not leave a catheter permanently in the bladder, but pass a No. 8 gum-elastic instrument every six hours for the first two or three days so as to draw off the urine. This can be done without risk to the union of the incision in the floor of the urethra if care be taken to keep the point in constant contact with the roof. No sutures are inserted in the skin wound; an antiseptic dressing is merely applied over it, and after the third day the patient may be allowed to micturate normally.



FIG. 77.—STRAIGHT STAFF
FOR PERINEAL SECTION.
This is the staff originally
designed by Aston Key for
lateral lithotomy.

CHAPTER XXXIX.

INFLAMMATORY AFFECTIONS OF THE URETHRA.

INFLAMMATIONS of the urethra may be divided into two great groups, namely, venereal and non-venereal urethritis, the former being far the commoner form.

GONORRHOEA.

This is the name given to venereal or specific urethritis which is due to a specific organism, the gonococcus of Neisser. This is a small coccus occurring in pairs or groups, the opposed surfaces of the cocci being somewhat flattened.

In the urethra the gonococci are found essentially in the epithelial cells. They may also be present in the pus cells but they are not found free in the gonorrhœal pus. They stain readily with aniline dyes but are decolourised by Gram's method and they may be cultivated outside the body, the best medium being serum; they require a temperature of from 25° - 37° C. for their growth. Other organisms are often found in the gonorrhœal pus but the gonococcus has been clearly shown to be the specific cause of the disease, the others being of secondary importance, although they may help to keep up the inflammatory condition. Among these other organisms are the ordinary pyogenic cocci, and it is probably to them rather than to the gonococcus that suppurative complications, such as bubo, are due.

The gonococcus especially attacks the urethral mucous membrane, but it may grow in the rectal or buccal mucous membrane to a slight extent; it flourishes well on the conjunctiva. It may be carried to other structures such as the various synovial or serous membranes in which it sets up inflammation. It is very difficult to extirpate from the male urethra, and in women it may remain for a long time apparently dormant in the folds of the vaginal mucous membrane, lighting up into its pristine activity under certain circumstances.

Great care is necessary in diagnosing a case of urethritis as gonorrhœal because there are various other causes of purulent urethritis; before any

case is definitely pronounced to be gonorrhœal the gonococcus must be recognised in the discharge both by microscopical examination and by cultivation. It is equally important that great care should be taken in pronouncing that any given case is cured. The fact that no gonococci are found in the discharge at any one time is by no means a proof that the trouble has disappeared. Repeated examinations should be made at fairly long intervals, and the absence of gonococci during a considerable period must be established before it is definitely announced that a cure has been obtained.

GNORRRHŒA IN THE MALE.—The inflammation commences in the anterior part of the urethra, particularly in the fossa navicularis, the organisms attacking the superficial layers of the mucous membrane first, but spreading to the deeper ones later on. The inflammation rapidly spreads from the fossa navicularis along the penile urethra, to which it may remain limited for a few days; it spreads into the posterior urethra however in the majority of cases, and the mode in which it does so is disputed, some holding that it extends directly along the mucous membrane, whilst others consider that the organisms find their way into the lymphatic plexus and are carried thence to the membranous and prostatic urethra. It seems certain that an acute urethritis does not remain limited to the anterior urethra after the second week of the disease.

The urethral mucous membrane becomes swollen, congested and thrown into folds, and the inflammatory exudation spreads into the submucous coat as time goes on, and may even reach the spongy tissue surrounding the urethra which then loses its elasticity and consequently does not stretch *pari passu* with the corpora cavernosa during erection, and therefore becomes unduly stretched and painful. This condition leads to painful erections known as chordee.

The usual incubation period is three to five days; occasionally it may be as long as a week, and a much longer period has been noticed in very rare cases. The susceptibility of individuals differs greatly, and the disease is not necessarily always contracted after exposure to contagion.

The acuteness of the inflammation usually increases for the first few days, and then remains more or less stationary for about ten days, after which it gradually subsides. In a typical case in which resolution takes place there is first the period of incubation, lasting for from three to five days, followed by the period of onset, lasting from three to four hours, during which there is irritation about the orifice of the urethra with swelling of its mucous membrane and slight mucous discharge. Then follows the acute stage, lasting for about ten days and marked by profuse purulent discharge with all the other inflammatory symptoms. Finally comes the period of subsidence, lasting two or three weeks in favourable cases, so that the case lasts about six weeks altogether when the disease runs its course without complications and without passing into the chronic condition known as gleet. In a large number of cases however the chronic

stage is prolonged for an indefinite time, the inflammation becoming localised to one or two areas of urethral mucous membrane, generally in connection with folds or crypts on its surface, and giving rise to the slight mucoid discharge known as gleet.

Complications.—Some of these are due to local extension of the disease, and some to infection of parts at a distance. Most of these complications are treated of elsewhere. Amongst the principal are balanitis, phimosis and paraphimosis, peri-urethral abscess, thrombosis, lymphangitis, bubo, epididymitis, prostatitis, vesiculitis, cystitis, retention of urine, gonorrhœal rheumatism and gonorrhœal ophthalmia.

Symptoms.—The first symptom is an irritation or itching about the meatus, the lips of which have a tendency to stick together. This is quickly followed by scalding on micturition and a profuse discharge of thick yellowish pus, the lips of the meatus being intensely red and swollen, and the affection often being accompanied by painful nocturnal erections, which may later assume the form of chordee (*vide supra*). Micturition is unduly frequent at first, probably owing to reflex irritation and not to extension of the disease to the bladder.

The acute symptoms subside in from about ten days to three weeks, the discharge becoming thinner and more watery in character until it either disappears entirely or remains as the mucoid discharge known as gleet (see p. 382). When posterior urethritis sets in acutely during the early stage, there is usually a diminution in the amount of discharge and a feeling of distension and burning in the perineum with markedly increased frequency of micturition; there may be also a few drops of blood with the last drops of urine caused by spasmodic contraction of the compressor urethræ upon the inflamed membranous urethra. There is usually great sexual excitation, with erections which may last for a long time and are more or less painful according to the condition of the corpus spongiosum. If the urine be passed into two glasses both portions will be cloudy and will contain shreds of mucus and pus, the first especially.

During the chronic period the discharge is best seen in the morning on separating the lips of the meatus and squeezing the fluid along the urethra, when a drop of viscid or even purulent discharge will be expelled. In the intervals between micturition the discharge dries up over the meatus so that the lips stick together, and this is especially the case in the morning when a considerable time has elapsed since the last act of micturition.

Treatment.—This must be considered in reference to the various stages, and will be divided into: 1. The treatment at the commencement of the attack; 2. During the acute stage; 3. During the stage of decline; and 4. The treatment of gleet.

1. Treatment at the commencement of the attack.—Here the question of *abortive treatment* presents itself and many plans have been adopted with a varying amount of success. It is obvious that any attempt

at true abortive treatment, that is to say the destruction of the bacteria, must be carried out before they have had time to penetrate the mucous membrane, where no antiseptic will reach them. Some twenty years ago, as the result of a number of experiments, one of us introduced a soluble urethral bougie¹ which, if introduced in the very early stage of the attack, often cuts it quite short. The advantage of this soluble bougie over the injections which are often used for this purpose is that its action is more prolonged and that it distends the urethral mucous membrane and so the drug is applied to the whole surface of the urethra. These bougies should be employed at the very commencement of the symptoms; if used after the first forty-eight hours they will probably do more harm than good because by that time the affection is firmly established and the application of antiseptics only causes irritation. When used before this period however much success has followed their use for, even if the disease be not entirely cured, the acute stage is often much mitigated and the disease becomes mild and amenable to treatment. The best way of using them is first to flush out the penile urethra thoroughly with boracic lotion and then to dip a bougie into eucalyptus oil and push it up the urethra until its end disappears well within the fossa navicularis. A small pad of dressing is applied over the meatus and a narrow strip of strapping outside that prevents the bougie escaping and keeps the material of which it is composed within the urethra as long as possible. The patient should not pass urine until he is compelled to do so. A second bougie may be used in a similar manner 12 hours after the first, but none after that. At the same time large doses of sandalwood oil (see p. 378) should be given.

If this treatment aborts the acute stage, as it often does, and only a thin discharge is left, astringent injections (see p. 379) may be used in two or three days' time and the sandalwood oil should be continued. The older plan for attempting abortive treatment was to inject strong solutions of nitrate of silver (1-1000 to 1-500 or less) at a similar period of the disease; latterly injections of protargol have been similarly employed.² We have found the bougies to be not only more certain in their action than these injections, but also less irritating if they do not succeed.

2. During the acute stage.—Here the treatment must be largely general; if local treatment be employed at all it must be unirritating, as

¹ The composition of this is iodoform, grs. 5, ol. eucalypti, m. 10, ol. theobrom. q.s. to make a cylinder four-and-a-half inches long and of No. 10 English gauge (see *Lancet*, 1882, Vol. II.).

² Some years ago one of us made numerous attempts to cut short the disease by applying various powerful applications methodically to the whole of the inflamed area through the urethroscopic tube. Although this method was more successful than the old plan of injection, it is open to the objection that it is not sufficiently certain in its results and that when it fails it is apt to increase the intensity of the affection to a very high pitch (see *King's College Hospital Reports*, Vol. I. p. 118).

its object is not to destroy the bacteria, for that is impossible, but to relieve the inflammatory symptoms, and therefore it must never go beyond attempts to wash the pus out of the urethra.

In the *general treatment* the patient should be kept as quiet as possible ; it is even advisable for him to stay in bed for a few days if possible, as complications are then less likely to occur. In any case active exercise should be avoided, as well as anything that tends to sexual excitement. A suspensory bandage should be worn from the first, but the edge of the bag must not press upon the urethra as otherwise it might lead to retention of pus and increase of irritation. The bowels should be freely evacuated by means of salines, and the urine kept dilute and unirritating by mild diuretics, such as citrate of potash (grs. 10-20 three or four times a day) or spirits of nitrous ether (℥ 20) with an alkali, such as carbonate of potash (grs. 20) ; in addition large quantities of diluent drinks, such as barley water, toast and water or infusion of linseed should be taken. In the very acute stage some sedative, such as tincture of hyoscyamus (℥ x-xx) or tincture of belladonna (℥ v), may be added. Alcohol must be entirely abstained from ; it is remarkable to see the increase in the inflammatory symptoms that follows transgression of this rule, at any rate in the acute stage. A light diet should be prescribed and red meats should be avoided, as should also coffee and tea.

The question of the administration of sandalwood oil or balsam of copaiba during the early stages has been much discussed. It is probably better to avoid these drugs until the acuter symptoms are beginning to pass off, as they may do much harm by upsetting the digestion and it is even possible that they may render the urine more irritating. The drugs are of great value however as soon as the inflammatory symptoms are beginning to subside (see p. 378). Some surgeons strongly advocate the use of salol during the acute stage as having a direct antiseptic action upon the urethra and they give it in 5- to 30-grain doses three or four times a day ; more recently urotropine in doses of 5-10 grains three times a day has been recommended for the same purpose. If there be much scalding on micturition and the patient dreads the act, a good plan is to let him pass urine into hot water either by micturating while in a hip-bath or by immersing the penis in a vessel of hot water.

Chordee is best treated by the administration of bromide of potassium. This drug does not produce its effect for some hours after it has been administered and it is therefore well to give it during the day as well as at bedtime. In any case a dose of 20 grains should be given about six o'clock in the evening and another about ten, and to this dose it is well to add tincture of belladonna (℥ v-xv). If this fails, a half-grain suppository of morphine at bedtime is of value. Minor degrees of chordee are generally relieved by a hot sitz bath or even by a cold douche ; when it is very troublesome, leeches may be applied to the perineum and the patient confined to bed, the foot of which is elevated.

It is very important to warn the patient as to the contagious nature of the discharges, and to urge upon him scrupulous personal cleanliness. The hands should not only be washed thoroughly after handling the penis, but they should also if possible be disinfected with 1-20 carbolic solution. Lint, wool, or dressings should be burned immediately they are removed, and care should be taken to prevent the discharges from coming into contact with the clothes or the linen; a gonorrhœa bag should always be worn and should be changed frequently, the old one being burned directly it is removed. These bags may be bought ready-made, and should consist of some medicated dressing. They should have a little salicylic wool placed at the bottom so as to absorb the discharge more readily and they are best fastened to a band around the waist. From time to time the glans penis should be washed, the prepuce being fully retracted.

Some advocate frequent irrigation of the urethra with warm water or salt solution as *local treatment* during the very acute stage, whilst others inject various antiseptics. To us it seems better to leave the urethra wholly undisturbed during the few days of the very acute stage. The likelihood of antiseptics doing any good in the way of destroying bacteria is extremely slight at this period, and they will certainly cause much irritation. Even the possibility of effectually washing away the discharge by unirritating solutions is open to doubt, seeing the folds into which the mucous membrane is thrown during the acute stage, and it is essential at this period not to dilate the urethra sufficiently to obliterate these folds as otherwise the discharge will almost certainly be carried down into the posterior urethra.

3. During the stage of decline.—From the practical point of view this is the most important period of the disease, as during it the future of the case is probably decided, and if it be improperly handled, the condition may go on to the chronic form known as gleet, which is very troublesome to cure. It is the stage during which the more vigorous treatment should be adopted.

The general treatment, with regard to hygiene and diet, should be the same as before, but during this period drugs, such as cubebs, copaiba and sandal-wood, are of value; of these sandalwood oil is probably more useful as it causes less gastric irritation. It should be commenced in small doses and should be rapidly increased. During the first day one capsule containing five minims should be given three times a day, whilst on the following day the dose is doubled, and on the third or fourth day the patient may take a dose of 15 or 20 minims three times a day if there be no symptoms of gastric disturbance. Salol (see p. 377) is also valuable at this period and urotropine has also been recommended.

The local treatment is of special value at this period and takes the form of urethral injections which may consist either of antiseptic or astringent drugs, the object being either to kill the bacteria or merely to attempt to get rid of the congestion of the parts.

Urethral injections.—It is advisable always to begin with mild solutions

in order to see whether they cause irritation. If this be the case it implies that the treatment has been begun too soon, and the injections must be omitted for a time. It is most important that the fluid injected should get into contact with the whole mucous membrane of the urethra, whilst at the same time it is equally important that it should not run back into the bladder, as, were it to do so, the discharge would be carried into the deep urethra or even into the bladder itself. In the first instance mild astringents, such as sulpho-carbolate of zinc (grs. i-ij ad ̄j) sulphate of zinc (grs. i-ij), chloride of zinc (grs. i-ij), protargol and nitrate of silver (1-6000 to 1-3000) or permanganate of potash (1-4000) are the best.

In practising urethral injections it is important in the first place to prevent the fluid finding its way into the bladder, and in the second, to insure that it comes into contact with all the folds of the urethral mucous membrane. There are two ways of carrying this out. The most convenient plan, when the discharge is scanty and it is essential to distend the urethra so as to get the injection fully into contact with all its folds, is to compress the urethra in the perineum close to the bulb, thereby preventing the possibility of the injection finding its way further along the urethra than this point. The contents of a glass syringe previously filled with the fluid, holding only about a drachm to a drachm and a half, and having a bulbous nozzle that will entirely fill the external meatus are gradually injected down the urethra until the latter is put fully upon the stretch. The syringe is then withdrawn, the lips of the meatus are pressed together so as to keep the fluid in the urethra for about two minutes, when the fluid is allowed to run away and the process is repeated. The patient should always pass urine immediately before the injection is practised in order to wash away as much of the discharge as possible, and so that he may avoid having to perform the act again for some considerable time; the effect of the local application is thereby prolonged. The greatest gentleness must always be used in practising the injection so as to avoid any injury to the urethral mucous membrane. The syringe should be boiled each time before use, and the fluid should be used at the body temperature.

Another plan, which is particularly useful when the discharge is rather more free, is to introduce a bulbous-ended catheter with a backward flow (see Fig. 78) down the urethra just beyond the posterior limits of the disease and then to flush out the front half of the urethra by copious injections through it after connecting the tube to the ordinary Higginson's syringe. There are two possible objections to this plan, one being that the bulb of the instrument may carry the discharge down before it, whilst the other is that it does not distend the mucous membrane sufficiently to obliterate the folds. In practice, however, there is found to be little risk of infection of the deeper parts of the urethra if micturition be performed immediately before the irrigation is carried out, whilst, if it be desired to distend the urethral mucous membrane, it can easily

be done by compressing the urethra in the perineum behind the bulb of the irrigator whilst the lips of the meatus are pressed around the tube. We ourselves prefer to reserve this method for the cases where the object is rather to secure copious irrigation when there is a free discharge, whilst the other plan is more suitable for those in which the discharge is slight. For irrigation of this kind many substances are employed; sulphate of zinc (grs. i-iv ad $\bar{3}$ i), chloride of zinc (grs. ss-ii), acetate of zinc (grs. ii ad $\bar{3}$ i), permanganate of potash (1-4000), perchloride of mercury (1-12000 to 1-2000), nitrate of silver or protargol (1-6000 to 1-3000), carbolic acid (1-60), sulphocarbolate of zinc (grs. ss-iv), methyl-violet, etc., the quantity used for injection being one to two pints at a time and the irrigation being repeated three, four, or six times a day if the patient can spare the time. The drugs we prefer are the salts of zinc and permanganate of potash in the earlier stages, whilst nitrate of silver is more useful in the more chronic cases.



FIG. 78.—URETHRAL PIPE WITH BACKWARD FLOW. This may be used either with a Higginson's syringe when copious irrigation is required, or with the syringe figured below it when smaller quantities are to be used.

The test as to whether a patient is cured is the absence of urethral discharge and shreds in the urine. It is not uncommon for patients to find, after all discharge has ceased, that if they pass urine into a glass the first portion contains a number of thread-like filaments; these should be examined for gonococci but, whether the latter be found or not, their mere presence generally implies that the disease is not cured. Of course if gonococci be found, the disease must be looked upon as infectious and, as we have already said, even the absence of these must not be taken to imply a perfect cure except after repeated examinations extending over a prolonged period,—three to six months. It is not uncommon to find that a patient who has ceased to have any discharge leaves off the urethral injection and the discharge comes back two or three days afterwards; or he takes alcohol and gets a recurrence. In these cases the injections must be repeated.

Of complications.—Most of the complications of gonorrhœa already referred to (see p. 375) are described elsewhere.

Peri-urethral abscess is not an infrequent complication, and the pus may find its way into the urethra, through the skin, or both. A urinary fistula may usually be avoided if the abscess be opened externally directly its presence is detected. When it opens spontaneously both into the urethra and through the skin a urinary fistula results; under certain circumstances it may lead to extravasation of urine. This matter is dealt with more fully elsewhere (see Chap. XL.).

Inflammation of Cowper's glands is not uncommon in gonorrhœa and generally occurs about the third or fourth week of the disease. There is much pain and a feeling of tension in the perineum, the pain being aggravated on sitting or walking. On examination a small ovoid tumour will be felt on either side of the middle line; it is said that the left gland is more frequently affected than the right. The swelling may gradually disappear under rest and the ordinary treatment for inflammation, but suppuration often takes place either in the gland itself or in the surrounding tissues. If an abscess occurs in the gland itself, the pus may find its way along the duct into the urethra and the duct may become dilated; urine then finds its way back into the cavity and a urinary abscess with urinary infiltration or rupture of the abscess externally and the formation of a perineal urinary fistula may result. In other cases suppuration occurs outside the gland and the pus finds its way towards the perineum, when incision of the abscess will put an end to the trouble. Occasionally the inflammation becomes more chronic and the glands remain large and hard for a very considerable time, only slowly disappearing.

The treatment should be that for acute inflammation in the early stages, with incision of the abscess if suppuration occurs, or excision of the gland should it be evident that suppuration is not occurring, but that resolution is not likely to take place for a long time.

GONORRHOEA IN THE FEMALE.—In the female the area of mucous membrane affected by the gonococcus is much larger than in the male and, although amenable to immediate treatment, it is more difficult to entirely eradicate the disease as it may remain latent in the vaginal folds for a long time.

The affection in the female commonly takes the form of vaginitis, the urethra being comparatively rarely affected. Zeissl states that in only about 5% of the cases is there any urethritis present. The disease has a tendency to spread to the cervix uteri, and the inflammation may extend into the Fallopian tubes, giving rise to salpingitis, and thence to the peritoneum where it produces a pelvic peritonitis which may become generalised. The glands of Bartholin are frequently affected and it is very difficult to get rid of the affection from this situation.

Treatment.—This is very similar to that for the male except that internal remedies have practically no value except when the urethra is affected. The value of copaiba and sandalwood oil in the male is that they are excreted in the urine and apparently exert a local antiseptic action and consequently in the female these drugs are practically useless. In the acute stage the treatment takes the form of local applications, such as hip baths and hot vaginal douches, whilst in the more chronic stages the various astringent injections already referred to (see p. 380) particularly nitrate of silver, are useful. The local application of strong solutions of nitrate of silver may be called for when the cervix uteri is affected.

GLEET.

In normal cases the discharge becomes steadily less purulent until it ceases in two or three weeks after the subsidence of the acute stage. Sometimes, however, it persists for a long time, and the condition is then called gleet. Gleet is essentially due to the localisation of the gonorrhœal mischief in the deeper layers of the mucous membrane or submucous tissue in some very limited area. The examination of a very large number of cases with the urethroscope has led us to the conclusion that in the majority of cases this area is a spot either in the penile urethra from three and a half to four inches from the meatus, or else in the deep urethra about the junction of the prostatic with the membranous portion.

The local lesions met with at this stage are very various. The commonest is the so-called "granular patch" which is seen through the urethroscope as a livid purplish area, somewhat raised from the surrounding mucous membrane, oozing readily on being touched and closely resembling granulation tissue. Next in frequency to the granular patch a condition of simple hyperæmia of a particular area of the urethral mucous membrane is met with. This is most common in the neighbourhood of the bulb; the vessels are dilated and unduly numerous, and the mucous membrane is bright red instead of being of its normal pink colour. Another, but less common, lesion is ulceration of the urethra; this is most often seen in the fossa navicularis, while sometimes it is met with as a small fissure about three inches down the penile portion. It is very common to find evidences of inflammation about the orifices of Littre's glands; in the normal urethra these are barely visible depressions; in the subject of gleet however they form livid areas the size of a pin's head, usually in groups. Occasionally they exude pus, or there may be a distinct swelling caused by the bulging of a distended gland. Another condition that careful urethroscopic examination, especially with the inflating apparatus (*vide infra*), may reveal, is the existence of submucous induration, which shows itself as a series of fine rigid bands standing out in relief when the urethra is distended; these bands are probably the forerunners of true stricture, although at the time they are first discovered the actual narrowing of the urethra is very slight indeed. Finally, there may be marked congestion of the prostatic urethra and hyper-secretion from its follicles.

TREATMENT.—The treatment of this stage must be almost exclusively by local applications. When the disease has become really chronic drugs have little or no effect upon it. Any article of diet or any form of exercise that is found to increase the discharge must naturally be avoided, as must also sexual intercourse or excitement. Alcohol should be taken very sparingly, if at all, and in any case champagne, beer and heavy wines should be interdicted. Drugs by the mouth are of little value; the patient commonly goes on taking sandal-oil, but this practically never influences the urethral discharge at all, while it may upset the digestion and

make the patient very miserable. Astringent injections are also generally futile in these cases; cases undoubtedly clear up under their use, but in all probability they would have cleared up equally well without them. A study of the conditions giving rise to the affection leads to the conclusion that any injection strong enough to influence the local lesion must be too irritating to be applied to healthy mucous membrane. The only precise and logical method of treatment is first to discover the situation and nature of the actual lesion, and then to apply suitable medication to it and not to other parts of the urethra; for this purpose the urethroscope (*vide infra*) is the only satisfactory instrument. Such instruments as urethral injectors and various forms of urethral caustic-holders have been known for a long time, but they are not only clumsy in actual manipulation but uncertain in their action, as they do not necessarily reach the affected area.

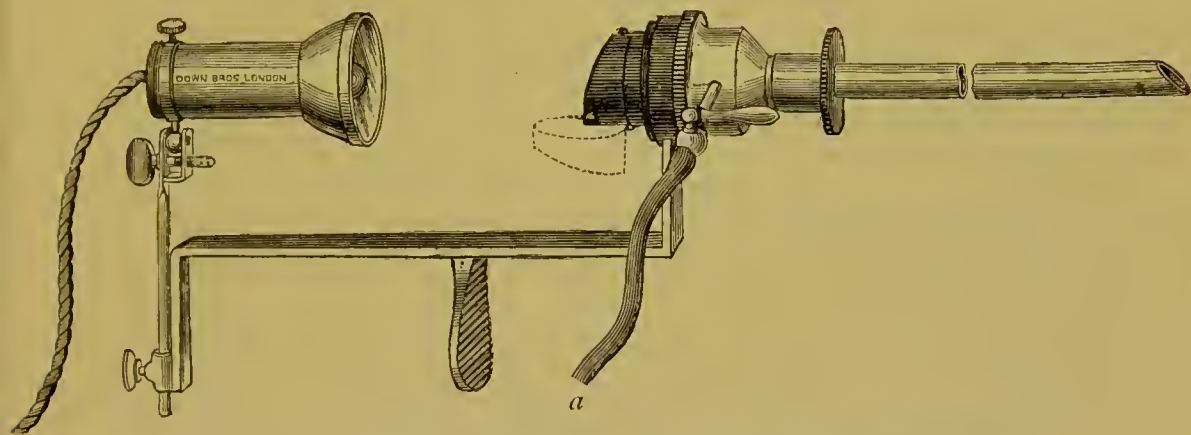


FIG. 79.—INFLATING URETHROSCOPE FOR USE IN GLEET. The instrument carries a lamp with a powerful parabolic reflector and is made with a short handle to facilitate working. The tube of the urethral inflating apparatus (*a*) is connected with a small hand bellows, and to use it the window at the proximal end of the tube is closed. This window is also shown in dotted outline as it falls back when probes or mops are passed down the urethroscopic tubes.

Urethroscopy.—With the urethroscope however (see Fig. 79) the urethra can be examined minutely from end to end, and any diseased area can be directly illuminated, its surface cleaned and examined, and even the strongest drugs can be applied directly to it without risk to the surrounding healthy mucous membrane. A properly performed urethroscopy forms as complete and accurate a method of examination and treatment as can be obtained at the present day. Certain precautions are necessary however before it can be used with success; care, gentleness in manipulation and a knowledge of the appearances met with in the healthy urethra are essential.

The urethroscope is used as follows: A tube of the largest size that the meatus will hold is disinfected by boiling,¹ warmed, lubricated with

¹ Strong carbolic lotion should be avoided as it irritates the urethral mucous membrane. If it be used for disinfection, the acid should be washed away by dipping the tube in boric lotion or boiled water immediately before introduction.

glycerine or boro-glyceride, and passed down into the membranous portion of the urethra. The best form of tube is shown in Fig. 80; the obturator is made of metal so that it is fairly heavy and will pass down the urethra by its own weight. The electric current may be obtained from the main by means of a transformer or from an accumulator. The urethroscopic tubes should be of comparatively large calibre, and should range from No. 10 to 16 English. It is very essential to pass as large a tube as possible so as to distend the various folds of the urethral mucous membrane

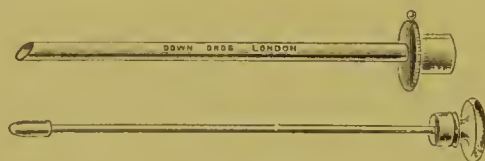


FIG. 80.—TUBE FOR USE WITH THE URETHROSCOPE. These are made of metal throughout, and are readily sterilised by boiling.

in order to see their condition exactly; very little useful information can be gained by inspection through too small a tube. There is a special inflating apparatus (see Fig. 79, *a*) for the purpose of distending the urethra, attached to the urethroscope. This is extremely useful for the detection of very early degrees of cicatricial narrowing. It is of the utmost importance to observe the most rigid asepsis with all the instruments; they should be boiled after use, as otherwise inoculation from one patient to another is very apt to occur.

The patient is instructed to say if the point of the instrument passes over any particularly tender spot in its progress, as this is often an indication of the whereabouts of the affected area. In ordinary cases the straight

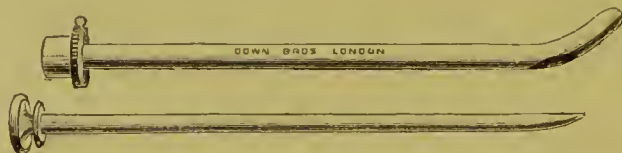


FIG. 81.—URETHROSCOPIC TUBE FOR USE IN THE PROSTATIC URETHRA.

tube is used, and is passed well down into the membranous urethra; it is easy to feel when the point goes through the triangular ligament. Should there be any reason to suspect mischief in the prostatic urethra, when for instance there is vesical tenesmus or deep-seated uneasiness in the perineum, the prostatic form of tube (see Fig. 81) should be employed, and should be pushed on practically into the bladder. It is desirable not to use cocaine for the examination if it can be avoided, as it destroys the sensibility of the urethral mucous membrane to a certain extent, and the indication afforded by the presence of a tender spot may therefore be lost. As a rule the passage of the instrument is not accompanied by anything more than slight discomfort.

When the tube is in position, the obturator is most carefully withdrawn, the urethroscope is attached to the tube and the electric light is switched on. A cotton-wool mop¹ is passed down the tube and made to cleanse the area of mucous membrane exposed at the bottom of the tube. If no abnormality be noticed in this, the tube is slowly withdrawn for a few millimetres, when the mucous membrane is again mopped up and examined, and this is continued until the whole of the mucous membrane has been examined from the membranous portion up to the meatus. Any area found to be affected receives its appropriate treatment (*vide infra*) as it is exposed. A most accurate examination can be made in this manner, and local treatment of various sorts can be applied. When the prostatic urethra has to be inspected, the tube will probably be passed into the bladder in the first instance as it is difficult to estimate the length of the urethra exactly, and in that case urine will be found in the tube when the obturator is withdrawn. If this be so, the tube must be withdrawn until the urine just ceases to flow, and then the fluid in it is mopped up with cotton wool as otherwise it will interfere with the view.²

Another important point in the technique is always to carry out the examination of the urethra from behind forwards and not from before backwards, as the bevelled edge of the tube is somewhat sharp and might excoriate the mucous membrane; the tube should never be pushed backwards towards the bladder after the obturator has been withdrawn but should always be passed to its furthest point and gradually withdrawn. Another point of practical importance is to make the application to the affected area upon a mop of suitable size which does not carry too much of the solution; if an excess be applied it will come into contact with the surrounding healthy mucous membrane and may set up an unduly violent inflammation. We are in the habit of passing a larger dry mop down the tube immediately after the application has been made in order to absorb any excess. The greatest gentleness in manipulation is necessary as the slightest injury to the urethral mucous membrane, leading to the production of only two or three drops of blood, is quite sufficient to obscure the view of the parts, and, when it is remembered that many of these cases are accompanied by granular patches which bleed on very slight provocation, the necessity for care in manipulation is apparent.

Local applications.—For *granular patches* the best application is a solution of nitrate of silver gradually increased in strength. When the

¹ A special wool-holder may be used, but a very simple plan is to roughen the end of a fine catheter stylet and roll the wool on that. The stylet is then bent at an angle of 120° about four inches from its handle, and forms a very useful urethroscope mop.

² A long prostatic tube, the elbow of which is closed by an obliquely-placed glass window, is sometimes used, and into this of course urine cannot find its way. This form of tube however is practically valueless, as the obliquity of the glass, the readiness with which its outer surface gets obscured, and the impossibility of cleaning it renders a good view difficult to obtain; topical applications are impossible through it.

mischiefs is comparatively extensive and scattered over the urethra, a mild solution should be employed, as otherwise the reaction may be severe. A solution of five grains to the ounce should be employed in the first instance and it will be found that the number of granular patches will steadily decrease and then stronger solutions (up to 3j or 3ij to the 3j) may be safely used to those remaining. The application should be made at intervals of about a week and during the time that the patient is under treatment the general measures for acute gonorrhœa (see p. 376) should be adopted; that is to say, the drugs there recommended should be employed and the patient should be instructed to practice irrigation if the discharge resulting from the application be troublesome. The effect of the strong solution of nitrate of silver is to set up a fairly acute urethritis which may even give rise to a blood-stained discharge for 24 hours or so; this only lasts however for two to four days. No other complication should occur if the application be carefully made, and the patient should always be told to expect an increase in the discharge.

In the treatment of *intra-urethral ulcerations*, especially in the fossa navicularis, very strong solutions of nitrate of silver (3j-ij ad 3j) or even the solid salt fused upon a probe or equal parts of carbolic acid and glycerine should be used. Special care must be taken not to allow the application to come into contact with the healthy mucous membrane; the surface must be dried after the application has been made, and a good plan is to fill up the urethroscope tube with boracic lotion so as to dilute and wash away any surplus salt. If the ulcer be in the fossa navicularis, a layer of salicylic wool may be packed over the surface and left in position until the patient micturates and washes it away. After an application of this kind to an ulcer we generally introduce a soluble bougie (see p. 376) and leave it in position. A little wool is applied over the meatus, the prepuce is drawn forwards and a gonorrhœa bag is applied outside.

Indurations of the submucous tissue may be treated in one of two ways. The minor varieties are satisfactorily overcome by the passage of full-sized Lister's bougies (15 or 16) or an Otis's urethral dilator. The old plan of passing bougies as a routine treatment for gleet probably owes whatever success it enjoyed to the fact that it succeeds in these particular cases. Marked indurations however are best divided by suitable urethral knives (see Fig. 82) introduced through the urethroscopic tube and made to nick the constriction. Two or three drops of an 8% solution of cocaine with a little adrenalin chloride are put down the urethroscopic tube and in five minutes the excess of fluid is mopped up, the knife is introduced down to the constriction and the latter divided by cutting downwards towards the floor of the urethra. This can be done without pain and in a few seconds, and more than one constriction may be divided if present. An iodoform bougie is introduced as before (*vide supra*).

Persistent inflammation or suppuration in Littre's glands calls for active treatment. It will suffice in most cases to touch any spot that fails to heal

after the application of a strong solution of nitrate of silver ($\bar{3}$ ij ad $\bar{3}$ j) with solid nitrate of silver fused upon a probe. When there is actual suppuration or when discharge is seen issuing from the orifice of the gland it should be treated by anæsthetising the surface (*vide supra*) and then slitting up the orifice of the follicle with a special sickle-shaped knife (see Fig. 82).

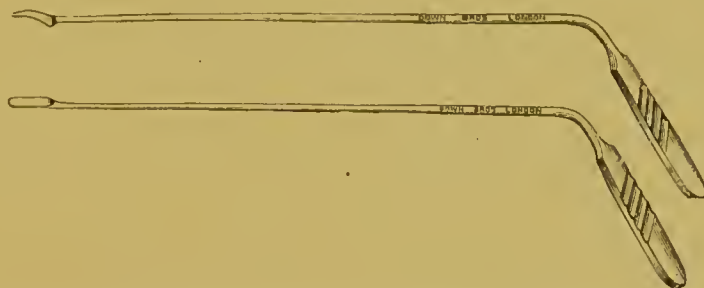


FIG. 82.—URETHRAL KNIVES. These are for use through the urethroscopic tube. The lower one is for dividing constrictions or indurations, the upper is for slitting up Littre's follicles.

The treatment of inflammation of the prostatic urethra is best effected by mopping out the prostatic urethra with solutions of nitrate of silver of medium strength (grs. v-xx ad $\bar{3}$ j). At the same time saline aperients should be given and alkalies and diluent drinks employed.

Results.—The results of these various methods of treatment in gleet are most encouraging. In a very large experience of these cases not a single complication has occurred and the inconvenience to the patient is quite trifling. It is found as a matter of practice that from three to five applications are necessary for the cure of an ordinary typical case.

NON-VENEREAL URETHRITIS.

This condition has already been referred to frequently in connection with the causes that give rise to it, and requires nothing more than bare mention here. It may be caused by various kinds of irritants to the urethral mucous membrane such as foreign bodies, urethral calculi catheters, etc., while occasionally it is met with in gouty subjects.

The treatment resolves itself into the removal of the irritating cause, when the affection usually subsides readily. Urinary antiseptics, such as salol (grs. x. t.d.s.) or urotropine (grs. v) may be usefully employed, as may also remedies for gout in suitable cases.

CHAPTER XL.

STRICTURE OF THE URETHRA.

UNDER this term are included all obstructions to micturition due to alterations in the wall of the urethra. Three forms may be distinguished, namely: 1. **Spasmodic stricture** in which the obstruction is due to spasm of the muscles surrounding the membranous urethra. 2. **Congestive stricture**, in which the difficulty is due to inflammatory swelling of the mucous membrane, generally gonorrhœal; when this condition causes complete retention it is associated with spasm of the membranous urethra. 3. **Organic stricture**; this is the most important form and will be described first.

ORGANIC STRICTURE.

In this condition there is an actual organic change in the urethral wall which leads to narrowing or rigidity of the canal.

CAUSES.—Organic stricture may be of two varieties: 1. It may be *traumatic* following rupture of the urethra; here the stricture is due to the contraction of the cicatrix formed during repair of the injury. When the urethra is completely divided an annular stricture forms, most commonly in the membranous urethra (see Chap. XXXVII.).

2. The great majority of cases of organic stricture are *inflammatory* in origin and are due either to repeated attacks of gonorrhœa or to long-continued gleet, in which the inflammation does not remain limited to the surface of the mucous membrane but involves the submucous coat and even the vascular tissue. This form of stricture occurs chiefly in the spongy urethra, most commonly at the bulb itself, and it may spread thence and involve the commencement of the membranous portion, although this is comparatively rare. Another common site of organic stricture is near the urethral orifice, while a third one is just in front of the scrotum at the point of flexure of the penis; stricture may occur however at any part of the spongy urethra. The stricture may be single or multiple. In very bad cases a considerable length of the urethra may be affected, the tightness

of the obstruction varying at different places and giving the impression of a number of independent strictures. As a rule the canal between the strictures in these cases is also contracted.

The prostatic urethra is never the seat of either a spasmodic or an organic stricture. When spasm occurs in its neighbourhood it is in the neck of the bladder itself and not in the urethral canal.

VARIETIES.—The common stricture in the bulbous urethra is usually extensive and consists of dense newly-formed fibrous tissue and is sometimes spoken of as a *callous stricture*. The chief formation of fibrous tissue occurs in the floor of the urethra, the roof being scarcely if at all affected, so that the urethral canal is displaced upwards; sometimes however the thickening is lateral, so that the urethra is diverted to one side.

Sometimes the material forming the stricture is extremely elastic and to this form the term *resilient stricture* is applied. These strictures are usually quite narrow and are most frequently met with in the penile portion. They are important from the point of view of treatment as, although they dilate easily, they do not undergo absorption as does the callous form of stricture.

A third form is sometimes termed a *bridle stricture*. In this the inflammation is practically limited to the floor of the mucous membrane which becomes raised as a sort of valve or band across the lumen; these strictures occur in the anterior part of the urethra.

RESULTS.—Organic stricture of the urethra is a most serious condition, as the interference with the outflow of urine causes changes along the whole urinary tract behind it. The urethra becomes dilated immediately behind the obstruction and in bad cases a large pouch may be formed. In this situation too the urethra becomes thinned and inflamed and may be ulcerated, so that actual rupture may occur when a patient with a tight stricture attempts to micturate; this leads to extravasation of urine (see p. 478). If rupture does not take place, the inflammation may extend into the peri-urethral tissues and give rise to an abscess communicating with the urethra, into which urine will be forced every time the patient passes water. In this way a urinary abscess is formed and extravasation of urine may occur when the abscess gives way; or the abscess may open in the perineum and a perineal urinary fistula may be established.

Serious changes occur in the bladder itself owing to the difficulty in evacuating its contents. In the early stages there is hypertrophy and diminution in capacity, whilst the organ becomes atrophied and dilated in the later stages. The back-pressure causes dilatation of the ureters and the renal pelvis and sepsis is very common in cases of long-standing and pyelitis or suppurative pyelonephritis (see Chap. XX.) then brings about the patient's death.

Cystitis is a common complication and may be very severe. It occurs apparently independently of the use of instruments, but the latter are

frequently the vehicles for the introduction of organisms, and all the conditions most favourable to the spread of septic inflammation are met with behind the stricture. Death may occur from cystitis, extravasation of urine, pyelitis or surgical kidney.

SYMPTOMS.—There is steadily increasing difficulty in micturition, the act takes abnormally long and in bad cases is unduly frequent; the patient frequently has a sensation of incompletely emptying the bladder. Urine is also apt to collect in the dilated urethra behind the stricture and to trickle through after the act of micturition is complete, so that the clothes are constantly wet and have a strong urinous odour. The forked and twisted stream usually described in text-books is not characteristic of stricture and when it is met with is usually due to stricture near the meatus; when the stricture is situated far back, the urethra is uniformly filled with the urine and the stream, though somewhat smaller in calibre than it should be, is not necessarily forked.

When complications like cystitis supervene they will be marked by their special symptoms. When the stricture is severe, particularly in gouty or rheumatic subjects, there is frequently purulent urethritis or a gleet discharge.

The actual diagnosis is made by examining the urethra with special instruments (see p. 391); this is also the first step in the treatment.

TREATMENT.—This varies in different circumstances. We may divide the cases met with in practice into two great groups, namely, 1. Uncomplicated strictures and 2. Strictures accompanied by complications. The latter class must be considered according to the various complications present and we shall divide them into strictures complicated (*a*) with false passages; (*b*) with cystitis; (*c*) with epididymitis; (*d*) with retention of urine; (*e*) with peri-urethral abscess; (*f*) with perineal fistula; (*g*) with extravasation of urine.

1. Of uncomplicated strictures.—These strictures are often divided into two groups which are termed permeable and impermeable strictures according as the surgeon is able to pass an instrument through them or not. Obviously there is no such thing as an impermeable stricture in uncomplicated cases, because there must be a channel representing the urethra as long as the patient can pass urine. The urethra may be temporarily occluded however and, even if it be not, it may happen, although rarely in skilled hands, that the surgeon is unable, even after many attempts, to pass an instrument through the stricture; as a rule he will succeed with patience and care in the vast majority of cases. The only true impermeable strictures are those in which perineal fistulæ are present and the patient has not passed any urine through the urethra for a considerable time owing to obliteration of the urethra from ulceration behind the stricture. The surgeon should always approach a case of uncomplicated stricture with the idea that it is possible to pass an instrument through it.

The treatment of simple uncomplicated organic stricture varies according to the character of the obstruction, and different methods are required for resilient, bridle and callous strictures; it may also be modified according to the number and situation of the strictures. The methods for dealing with simple uncomplicated strictures may be classified as 1. Intermittent dilatation; 2. Continuous dilatation; 3. Internal urethrotomy; and 4. External urethrotomy. The use of caustics or forcible dilatation is very rarely resorted to and is not to be recommended; similarly, destruction of the stricture by electrolysis, which was in favour for a short time, is seldom practised now and need not be considered. We shall describe the ways of dilating strictures first, as they are the methods most in use; even when urethrotomy is to be performed, some dilatation of the stricture must as a rule precede the operation. Before doing this however we shall describe the method of examination for the diagnosis of a stricture.

In examining for a stricture it is not unusual to mistake spasm of the urethral wall for an organic stricture. Anyone who does this runs the risk of pronouncing that a patient has a stricture when one does not exist. It may be taken as an axiom that any instrument that will pass through the meatus should pass without difficulty through the rest of a normal urethra; in order therefore to ascertain whether a stricture is present the first instrument used for exploration should be one as large as the meatus will admit. If the surgeon accepts the patient's statement that he has a stricture and commences with a small-sized instrument, he may be easily misled into thinking that a stricture is present when none exists, as the point of a fine bougie is apt to catch in the folds of the mucous membrane and this will not only impede the passage of the instrument but will set up spasm which will interfere with the examination still further. Moreover, with a small instrument a stricture may be overlooked as all strictures are not necessarily narrow, and a stricture that will not admit a No. 6 may allow a No. 3 or 4 to pass without hindrance. Another point of importance is that the instrument should be rigid as well as full-sized. A flexible instrument cannot well be guided. A No. 12 English metal bougie is generally employed first for diagnostic purposes.

The patient should lie on his back and, after having taken all the aseptic precautions already referred to (see p. 336), the surgeon stands at the patient's left side, grasps the penis just behind the glans and puts it on the stretch. In attempting to pass instruments the direction and length of the various portions of the urethra should be remembered. Thus, if the organ be held vertical, the bougie must first pass directly downwards for about six inches, until it reaches the commencement of the membranous urethra; this portion then runs almost horizontally for about three-quarters of an inch, and the prostatic urethra curves forwards and upwards for about an inch and a quarter before the bladder is reached. The mistake usually made is that the point of the instrument is not passed down far enough in the bulbous urethra and the handle of the instrument is prematurely

depressed, so that its point is thrown up against and perforates the urethral roof just in front of the membranous urethra (see Fig. 83).

There are three methods of passing a catheter. (*a*) In the first plan (see Fig. 84) the instrument is held parallel with the long axis of the body, its handle lying almost flat on the abdominal wall. The penis is held erect, the tip of the instrument is insinuated down it until the bulb

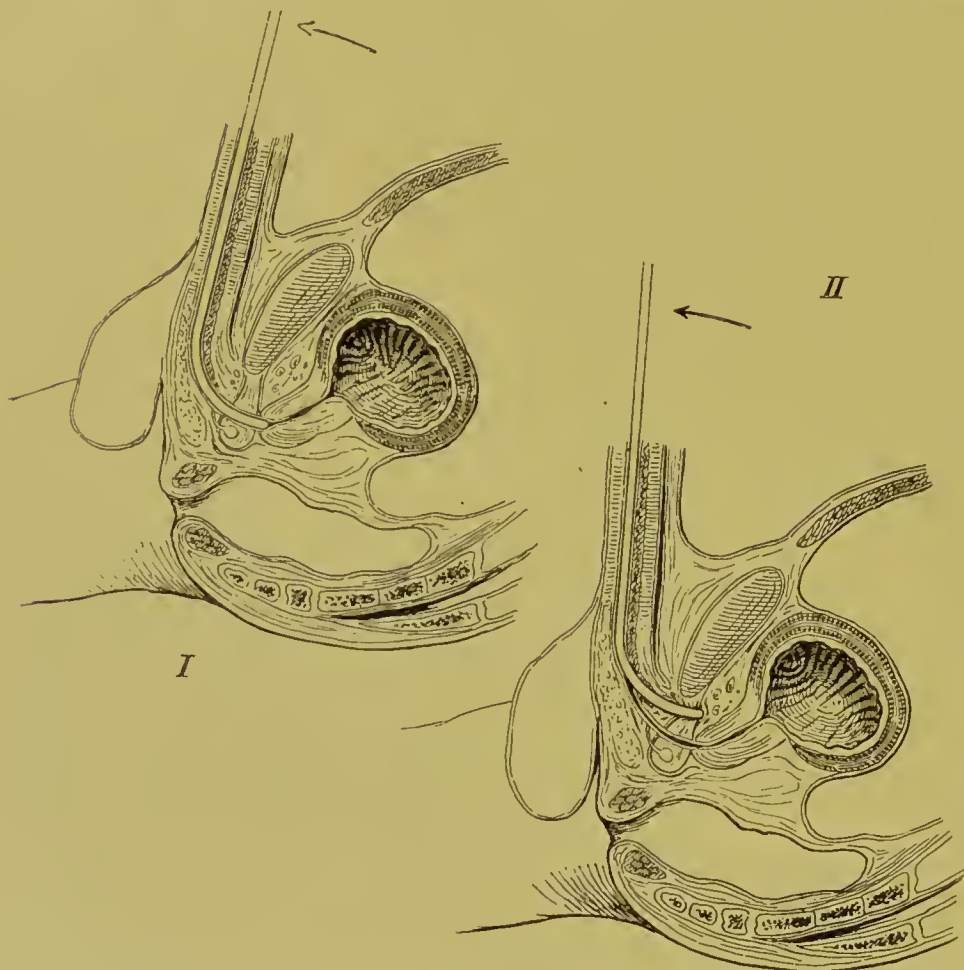


FIG. 83.—DIAGRAM TO ILLUSTRATE HOW A FALSE PASSAGE MAY BE MADE BY DEPRESSING THE HANDLE OF THE BOUGIE PREMATURELY. In I, the point of the instrument has been well engaged in the membranous urethra before the handle is depressed, while in II, the handle has been depressed before the triangular ligament was reached. This causes the point to pass out through the urethral roof. The point of the bougie should not be so high as it is shown in the figure; it should be already passing behind the prostate.

is reached, and then the handle is gradually raised to the vertical so as to engage the point of the instrument well in the membranous urethra. The handle is finally depressed between the thighs, and the point is made to pass upwards and forwards through the prostatic urethra into the bladder.

(*b*) Another plan (see Fig. 85) is to introduce the instrument at right angles to the long axis of the body, generally on the left side, until the point reaches the bulb. The handle is then rotated through a quarter of a circle until the shaft lies in the middle line the handle being also

slightly raised at the same time so that it does not lie upon the abdomen. This latter manœuvre is important; without it the point of the instrument

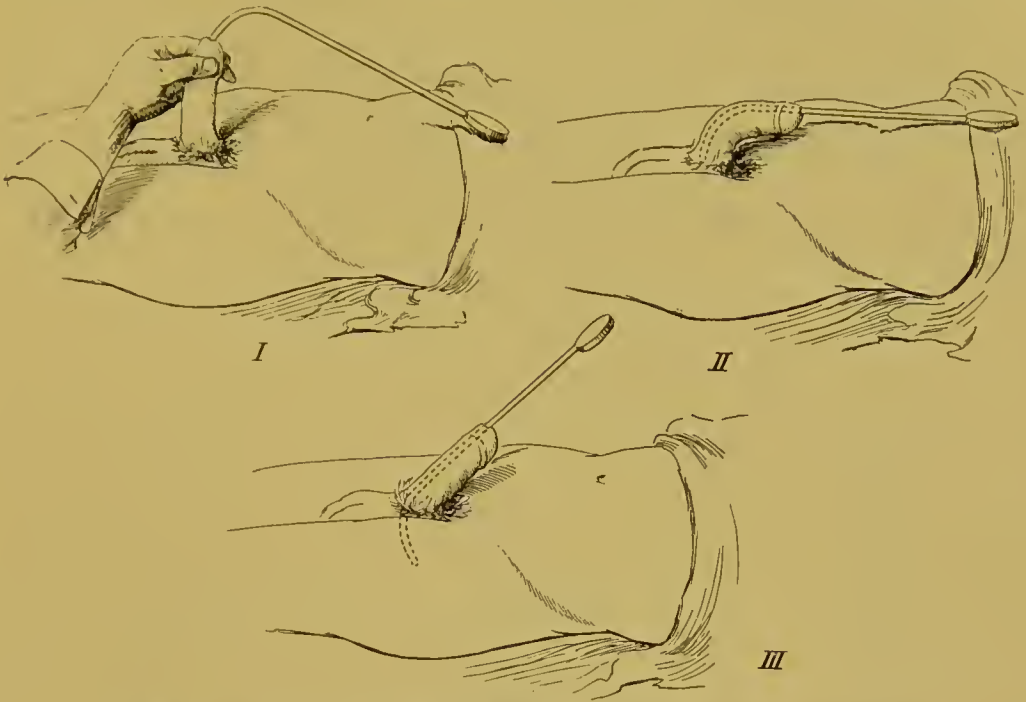


FIG. 84.—ONE METHOD OF PASSING A BOUGIE INTO THE BLADDER. The instrument is kept in the vertical median plane of the body throughout.

is apt to be somewhat withdrawn during the rotation, and does not enter the membranous urethra. All that now remains is to raise the handle

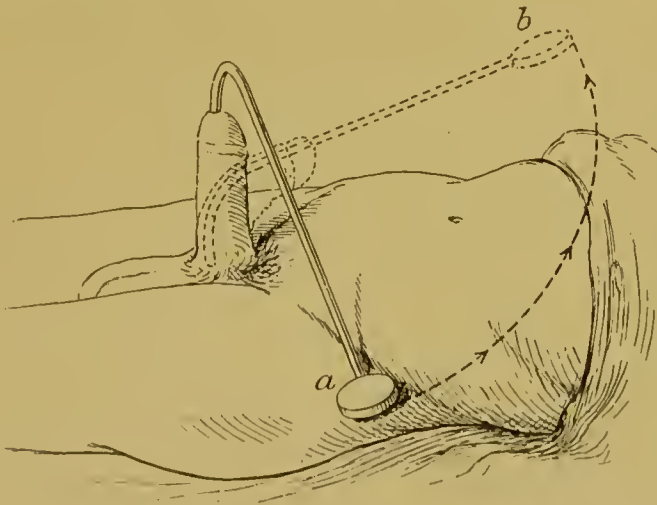


FIG. 85.—ANOTHER METHOD OF PASSING A BOUGIE. This is the "demi-tour de maître." The first position is marked *a*, and when the tip of the instrument has been passed well down to the triangular ligament in that position, the handle is brought up to *b*, from that to the vertical and finally down between the thighs.

to the vertical, and then to depress it between the thighs so as to pass the prostatic urethra. This is the so-called "demi-tour de maître."

(c) The third method, which is not necessary for diagnosis but may be of value in attempting to pass an instrument through a narrow stricture, is the so-called complete "tour de maître" (see Fig. 86). In it the instrument is passed as in (b) until the point is as far down the bulb as it will go. Instead of rotating the instrument up to the middle line it is now rotated downwards between the thighs, then across the opposite thigh, *i.e.* the right, and then from that point to the middle line. During the whole manœuvre care is taken to keep the point well pressed down in contact with the stricture. This plan has the advantage that it brings the point into contact with various portions of the stricture in succession, and therefore it may at some point slip through it.

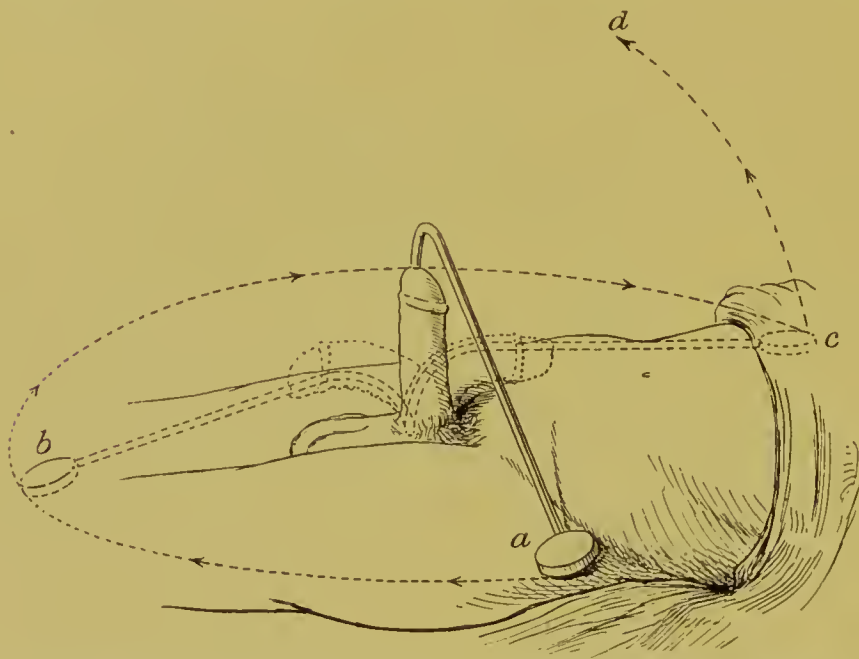


FIG. 86.—THE "TOUR DE MAÎTRE." The arrows show the course taken by the handle of the instrument. It goes from *a* to *b*, thence to *c*, and finally to *d* and down between the thighs.

A No. 12 English bougie will pass easily into the bladder, at any rate after a little firm pressure, when introduced by either of the two first methods mentioned if no stricture exists, provided always that it will pass through the external meatus, and provided no attempt be made to get the instrument into the bladder before the point is properly engaged in the membranous urethra. If on the other hand a stricture be present, the instrument will be arrested. The surgeon must then determine whether the obstruction is due to an organic stricture or whether the instrument is merely caught in a fold of mucous membrane or is arrested by spasm. If the arrest occurs in the spongy urethra it will be due to one of the first two causes, as sufficient spasm to arrest an instrument is not met with in this situation. If the trouble be due to a fold of mucous membrane, this is easily overcome by withdrawing the instrument for a short distance, and putting the penis firmly on the stretch in the erect position,

when the instrument will readily pass on; if it fails to do so in spite of this, a true organic stricture is present.



FIG. 87.—LISTER'S GRADUATED METAL BOUGIE.

When however the instrument is arrested on its way from the bulbous into the membranous urethra, the obstruction may be due to spasm of the latter. Therefore, before concluding that a stricture is present and withdrawing the instrument, gentle pressure should be kept up against the obstruction for a short time to see whether the instrument will not pass into the bladder, as spasm usually gives way suddenly. If in spite of this the instrument will not pass through the triangular ligament, an organic stricture in the bulbous or bulbo-membranous portion will be diagnosed. Obstruction to the passage of an instrument in the prostatic urethra is due either to enlargement of the prostate or to spasm of the sphincter vesicæ.

In this way the existence of a stricture is diagnosed, and the distance from the meatus at which it is situated should always be measured off along the bougie for future reference. The examination does not cease here however, as it is necessary to ascertain the length and tightness of the stricture and whether more than one is present. Hence smaller instruments must now be employed, both for examination and also for treatment.

When the surgeon has failed to pass a full-sized instrument (No. 12) the next size chosen should be a No. 9-12 Lister's graduated metal bougie (see Fig. 87); should that fail, a No. 7-10 should be tried, and so on downwards, substituting the soft black olivary or acorn-tipped bougie (see Fig. 88) for the metal instrument below a No. 6.

It is important to ascertain the length of the stricture, especially when an internal urethrotomy is likely to be required, and this may be done by using bulbous-ended instruments or better still the acorn-tipped bougies (see Fig. 88) which not only meet with resistance when they enter the stricture but, owing to the shape of the shoulder, meet with resistance when, having been passed through the



FIG. 88.—ACORN-TIPPED BOUGIE FOR THE DIAGNOSIS OF URETHRAL STRICTURE.

stricture, an attempt is made to withdraw them. In this way the distance down the urethra both of the anterior and posterior edge of the stricture, and therefore its length, may be obtained.

It is also important to ascertain whether there is more than one stricture present. This is easy if the stricture that is situated nearer the bladder be tighter than the one beyond it; if the largest instrument that the distal stricture will admit be passed, it will become arrested by the tighter stricture further down. If on the other hand the distal stricture be the tighter of the two, the proximal one will probably escape recognition until the distal stricture has been dilated beyond the number that the proximal one will admit. A final point of some importance about which information may be gathered from an examination like this is the dilatability of the stricture. By using graduated bougies as recommended below, the resistance of the stricture to the dilating force may be gauged to some extent and an idea may be gained as to whether the stricture is readily amenable to dilatation or not.

There is considerable difference of opinion as to whether a rigid or a flexible instrument should be used for this purpose when the smaller numbers (from No. 6 downwards) have to be used. The advocates of metal instruments argue that with them the surgeon is able to work with greater precision, as he can guide the point in the direction in which he desires it to go; whereas a small flexible instrument is apt to curl up in the urethra and does not take the direction that the hand desires to impart to it. On the other hand those who advocate flexible instruments hold that it is difficult to direct the point of a fine instrument intelligently among the numerous folds met with in the urethra and further that it is often impossible, even in the most skilled hands, to avoid doing damage to a sensitive urethra. However this may be, it would seem that the wisest plan is for all but those who are specially skilled in the passage of bougies to refrain from using metal instruments of a smaller calibre than No. 5 English except under special circumstances. With the fine flexible instruments they can at least do no harm, and repeated attempts will generally counterbalance early failures.

On the other hand there is a distinct advantage in using metal instruments of such a size that their points are not likely to become entangled in the folds of the mucous membrane and are not likely to penetrate the urethra if they do. Metal bougies from No. 6 upwards can be more easily guided and are under better control, while at the same time the resistance imparted to them by a stricture is more easily detected than with a soft instrument. These remarks apply equally to the passage of instruments for investigation and for dilatation.

Dilatation.—The object of this method of treatment is to place the patient in a position in which recurrence of the stricture may be prevented with a little care. Dilatation moreover is a necessary preliminary to other methods of treatment such as most forms of urethrotomy, and it is therefore important for the surgeon to be adept at it.

The instruments used for dilatation may be either rigid or flexible; we have already given indications with regard to the choice of these (see p. 396). The best metal bougies are Lister's (see Fig. 87) which are conical instruments increasing three sizes from the tip to the shaft. The tip is bulbous so that, when the point has passed through the stricture, the narrow neck lies loose in the latter and the surgeon can therefore gently manipulate the conical portion through the stricture and thus dilate it. Of the soft instruments the best are the black olivary bougies (see Fig. 89) which are similar in principle. The solid instruments have the ordinary urethral curve; but, if the stricture be situated in the penile urethra in front of the bulb, a simple plan is to use straight instruments graduated in the same manner. By holding the penis vertical and putting the urethra fully on the stretch, straight instruments are more easily manipulated through the stricture. No attempt however must be made to pass a straight metal instrument further than the bulb.

Intermittent dilatation.—Before proceeding to describe the steps of the treatment, there are a few points in connection with it deserving special mention and the first is that in a case of multiple stricture no attempt should be made to deal with the deeper strictures until the upper one has been dilated sufficiently freely to enable the instrument to be used for the dilatation of the deeper ones to be passed freely through it. If the anterior stricture grasps the bougie firmly, the surgeon has no control over the point, and attempts to pass it on through a deeper stricture are very likely to end in making a false passage. This is a most serious matter in these particular cases because, whereas a false passage is only serious as a rule in so far as it renders the passage of an instrument through the stricture difficult, a false passage between two strictures gives rise to very appreciable risks. Urine rarely finds its way down a false passage that has been made in front of a stricture in the ordinary way, as the false passage runs in the same direction as the urethra and the urine, after passing through the stricture, finds its way out of the urethra more readily than along the false passage and so there is no risk of urinary infiltration. If, however, the false passage be situated between two strictures and the stricture in front be not fully dilated, there is obstruction to the flow of urine and the latter may therefore find its way along the false passage and lead to urinary infiltration.

Another point in dilating a stricture, particularly by the intermittent method, is not to do too much at one time. Opinions vary much as to



FIG. 89.—OLIVARY FLEXIBLE "BOUGIES A BOULE." Each instrument is bulbous ended, and made of flexible material. The olivary end is mounted on a thin neck which gradually tapers up to the shaft.

the degree to which dilatation should be carried at one sitting, some surgeons holding that it may be carried to a full size, whilst others stop it at some arbitrary number, say, No. 7. No hard and fast rule however should be applied to these cases, and the surgeon must be guided by circumstances. He should always err if possible on the side of going slowly and gently. If the stricture be tight and instruments are passed with difficulty, a certain amount of splitting will result if the dilatation be too rapidly effected, and much inflammation and swelling will follow, accompanied of course by risks of septic absorption. Attempts to dilate the stricture up to No. 12 or 14 at the first sitting are very likely to end in some amount of damage. It must be remembered that the cure of a stricture by dilatation is not a purely mechanical one. In some way which is not clearly understood, the passage of an instrument through a stricture leads to absorption of the inflammatory products and this plays a far more important part than the mere stretching occasioned by its introduction. If the stricture be so rapidly stretched that it is actually torn, there is a risk of inflammation occurring and this will be followed by the formation of new fibrous tissue which contracts and so defeats the object of the dilatation. If the stricture be very tight, the best plan perhaps is to try a second after passing one instrument and, if that passes, to be content, for the stricture will then be dilated four sizes. In strictures however that are not very tight and that are easily dilatable, the process may be safely carried beyond this point and three or four instruments may be passed in succession. If the attempt to pass the second instrument does not succeed at once, it is better to desist rather than to irritate the urethra by prolonged attempts, as the surgeon may be satisfied with having succeeded in passing the stricture on the first occasion; on the second there will not be the same difficulty.

All precautions as to sterilisation of instruments (see p. 336) must be scrupulously carried out, and the instrument should always be well warmed and thoroughly oiled. It is a good plan, especially in cases of tight stricture, to inject about half a dram of sterilised oil into the urethra, so that there may be a sufficient quantity of lubricant in the neighbourhood of the stricture; if the instrument be lubricated in the ordinary way, the urethral mucous membrane may rub off the lubricant by the time the neighbourhood of the stricture is reached. If it can be conveniently arranged, the patient should always be kept in bed for a day or two before the first instrumentation is carried out. A general anæsthetic is usually unnecessary except under special circumstances. Should the urethra be irritable or the patient nervous, local anæsthesia (20 drops of an 8% solution of eucaine injected down the urethra) will help considerably. Should the urethra be congested, the addition of adrenalin chloride (1 in 1000) to the above will still further help by diminishing the vascularity of the parts.

In dilating a stricture, the surgeon stands on the left side of the patient and begins with the largest-sized instrument that previous examination has

shown him the stricture will admit, passing it in the manner already described (see p. 392). In using fine instruments the point often catches in folds of the mucous membrane as it passes down to the region of the stricture and this is best avoided by keeping the penis vertical and putting it well on the stretch so as to obliterate the folds as much as possible.

When a metal instrument is used the chief error likely to be made in deep-seated strictures is to think that the opening in the triangular ligament has been reached before it really has. The handle of the instrument is thus raised prematurely and its point is forced through the roof of the canal running thence down beside the urethra, behind which it passes until it lies between the prostate and the rectum (see Fig. 83).

When the point of the instrument has arrived at the stricture, the greatest gentleness must be employed, and the surgeon should try to find the passage through it by using the instrument more as a probe; the handle should be lightly grasped between the thumb and forefinger and no pressure should be exerted while the position of the tip of the instrument is altered in the attempt to find the way through the stricture. If this fails the "tour de maître" (see p. 394) will often succeed if a metal instrument is being used. No attempt should be made to force the instrument onward until it is definitely engaged in the stricture. The grip of the stricture is quite characteristic and when it is felt it is allowable to force the instrument gently onwards; even here however no great amount of force should be used.

In difficult cases the left forefinger may be introduced into the rectum and pressure made by it at the junction of the membranous with the prostatic urethra as the handle of the instrument is raised. The finger in rectum will also help the surgeon to be sure that the instrument has not gone into a false passage. When a false passage has been made, the point of the instrument lies between the prostate and the rectum and is felt clearly by the finger in the rectum; if, however, the bougie be in the urethra, the substance of the prostate intervenes between the finger and the instrument.

When small flexible instruments are employed, the black olivary bougies (see Fig. 89) are generally chosen; for the very tight strictures catgut or whalebone instruments may be used. Much patience must be exercised, as there is little power of guiding the tip of the instrument. These fine instruments are easily passed down to the stricture; if the point catches in the mucous membrane the bougie is withdrawn for a quarter of an inch or so and then passed onwards, the penis being kept fully on the stretch. When the face of the stricture is reached, attempts are made to find the opening and insinuate the point of the bougie through it by frequently withdrawing the instrument slightly and then pushing it on. When the point becomes engaged in the stricture the bougie can often be easily passed through it if a slight rotary movement be imparted to it so as to screw it through the stricture as it were.

In the treatment of tight strictures the so-called "urethral whips" (see Fig. 90) sometimes meet with great success. These are very long soft

instruments tapering from a very fine point to a stout stem, the difference between the two ends being as much as eight or nine sizes. When the point of one of these instruments is got through the stricture, the rest of it is pushed on until the stricture is well dilated, the fine flexible end of the instrument curling up in the bladder. These instruments have the advantage that most of the dilatation is done with a single introduction. They have the disadvantage however that they are not so easy to manipulate as the smaller forms; their length makes them somewhat unwieldy and they cannot be twisted through a tight stricture in the same way.

After the first sitting the patient should be kept in bed for 24 hours at least and an interval of three days should be allowed to elapse before a second is undertaken. At this sitting an instrument of the same size as was originally passed on the first occasion should be used first, and two or three more instruments may be passed in succession. Three days are again allowed to elapse and the third sitting commences with a size larger than that passed first at the second sitting and is carried a little further. By proceeding in this gradual manner a 9-12 can be passed in two or three weeks and as a rule it is well not to go beyond this for one or two sittings. A certain amount of over-dilatation may be practised with advantage however if it be found that the stricture dilates easily, and the stricture may be dilated up to a No. 15 English. When this stage has been reached, the interval between the passage of the instruments may be increased. In the first place they should be passed every four or five days; then a week may be allowed to elapse; then ten days and then a fortnight. After that,

an instrument should be passed once every two or three weeks for several weeks, when the interval may be increased to a month or two, or even three. It is well however not to allow the patient to abandon instrumentation entirely, as otherwise recurrence is apt to occur as time goes on.

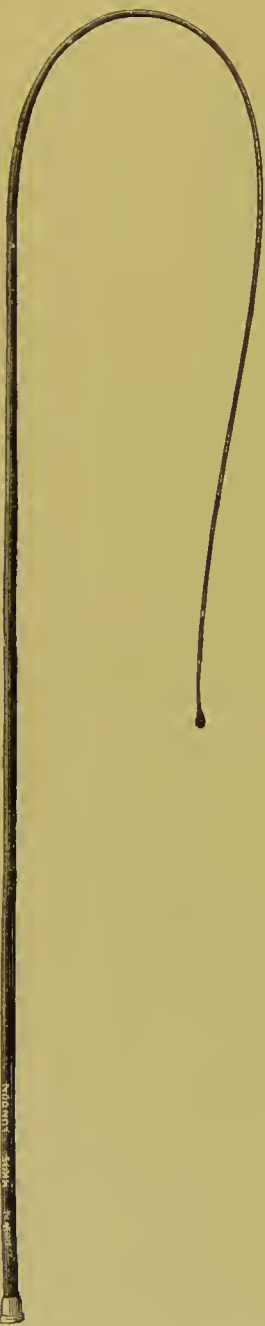


FIG. 90.—HARRISON'S "URETHRAL WHIP" BOUGIE.

The surgeon should pass an instrument at least once or twice a year, both because it is advisable that he should see whether there is recurrence and also because he can do it better than the patient himself. If however the patient be situated so that he cannot have instruments passed by a surgeon, he should use a soft black tapering bougie, the tip of which measures No. 9 and the shaft 12 or 13; this can be got through the stricture quite easily and without any risk of damage if it be well oiled and warmed. He should pass an instrument of this kind every three months, keeping it in position for ten or fifteen minutes at a time, and the procedure should be repeated oftener if there be any difficulty.¹ He should never be taught to pass metal instruments as otherwise he is very likely to do damage at some time or other.

Continuous dilatation.—This is not a method to be recommended save under exceptional circumstances. When for instance the patient has been suffering from retention and a catheter has been introduced into the bladder with difficulty through a very tight stricture, tying in the instrument insures evacuation of the bladder, while at the same time absorption of the stricture will go on and subsequent instrumentation will be facilitated. Another indication is when the stricture is too rigid to yield to intermittent dilatation; if it be evident that no real progress is being made after two or three attempts by the intermittent method, a trial may be made of continuous dilatation before resorting to a cutting operation. It should never be attempted however when there is grave cystitis or renal disease; in these cases dilatation of any kind should be avoided.

In continuous dilatation a catheter is introduced through the stricture, and tied in position and left for 24 hours. The instrument should lie comparatively loosely in the stricture and there is no need to pass the largest size that the stricture will admit. At the end of 24 or 48 hours it will be found that dilatation of the stricture has taken place and an instrument one or two sizes larger can be introduced easily and tied in. In the course of a few days the stricture is thus fully dilated.

The method necessitates the confinement of the patient to bed and he should take some form of urinary antiseptic (see p. 274) internally and, if there be trouble from erections, bromide of potassium and chloral may be given once or twice daily, combined if necessary with a suppository containing a quarter of a grain of extract of belladonna and a grain of extract of hyoscyamus. The objections to the continuous method are chiefly those due to the presence of an instrument in the urethra; this is apt to give rise to urethritis, which may spread into the bladder and set up cystitis.

¹When a patient passes instruments for himself, the greatest stress must be laid upon the necessity for using absolutely sound instruments. Any instrument that shows cracks or any imperfection should be destroyed at once and a sound one substituted. Patients are very apt to use rough and cracked instruments which easily damage the mucous membrane.

Accidents attending the passage of an instrument.—Several embarrassing and even serious accidents may accompany the passage of an instrument. Occasionally there is much *shock*, and the patient faints and remains collapsed for a time. This is especially the case with neurotic subjects and may occur even when the greatest gentleness is employed. When the patient is known to be very neurotic it is well to administer a small dose of morphine previously or to apply eucaine to the urethral mucous membrane; twenty minims of an 8% solution of eucaine are taken in a Guyon's syringe, the nozzle is introduced about an inch down the urethra, when a few drops are pressed out, and the nozzle is passed further on and more injected, and so on, until the whole of the urethra down to the stricture has been brought into contact with the drug. The lips of the meatus are pressed together so as to prevent the fluid escaping and in ten minutes the mucous membrane will be fairly insensitive. The administration of brandy or a diffusible stimulant, such as sal volatile, is called for when shock has actually set in and the patient should stop in bed for the rest of the day.

There may be a good deal of *hæmorrhage* in some cases even without the formation of a false passage or the production of any serious laceration of the mucous membrane; it is most likely to occur in plethoric patients who have been over-drinking or over-eating and in whom the urethral mucous membrane is much congested in the neighbourhood of the stricture so that a mere touch with a soft instrument provokes bleeding. As a rule this trouble may be avoided if the patient be confined to bed for a few days before commencing the treatment, put on a low diet, purged freely with salines, and tincture of hyoscyamus administered. A very useful preliminary to instrumentation is the injection of eucaine (*vide supra*) combined with a small quantity of adrenalin chloride (1 in 1000); after this has been done, it is well to fill up the urethra with sterilised oil so as to insure that the lubrication of the instrument is perfect. Soft instruments should be used in the early stages and metal instruments should be substituted when the stricture has been dilated up a few sizes.

The surgeon meets with *false passages* under two conditions; he may make them himself and be conscious of doing so, or they may have been made previously by another surgeon or by himself. The existence of a false passage greatly complicates the case, for an instrument passed along the urethra almost invariably finds its way into the false passage because the opening of the latter is more in the direct line of the point of the instrument than is the passage through the stricture; moreover, the orifice is swollen and gapes. The surgeon can generally tell that the instrument is in a false passage by the fact that it passes well beyond the region of the stricture and yet meets with an obstruction and—if it be a metal instrument—cannot be rotated as it could be were it in the bladder; the finger in the rectum will feel the tip of the instrument close beneath the rectal wall. If a catheter be used instead of a bougie, the failure to draw off urine indicates

that the instrument is in a false passage. A false passage bleeds freely immediately it is made, but instruments passed very gently along a false passage of some standing do not necessarily excite any bleeding. For treatment see p. 410.

Catheter fever has already been described (see p. 338). It has been supposed by some that it is not the actual passage of the instrument through the stricture that gives rise to this condition but its contact with the prostatic urethra, and some surgeons have asserted that in patients who were subject to this complication they have avoided it by not introducing the instruments further than the stricture. The best prophylactic is to keep the patient in bed for 24 hours before instrumentation, and to administer two five-grain doses of quinine shortly before it.

Epididymitis is a rarer complication of catheterisation and generally results from direct infection from the urethra when the stricture has been fairly tight and has been split by dilatation. Its treatment is described later (see p. 452).

Cases suited for treatment by dilatation.—The majority of strictures can be treated in this manner, at any rate for a time, for, even if the treatment be not curative, it may be required as a preliminary to other operations, such as internal, and some forms of external urethrotomy. Ordinary strictures in the vicinity of the bulbous urethra are very suitable for treatment by intermittent dilatation. Those in the penile portion are usually of a more resilient character and should be submitted to operation. A stricture may be said not to be suitable for this method when it either is so rigid as not to become absorbed after prolonged attempts by intermittent dilatation or is so resilient as to relapse each time; there is then no alternative but to operate. Similarly cases complicated by numerous false passages, with abscesses or fistulæ behind the stricture or with attacks of epididymitis and catheter fever are better submitted to operation. Finally of course the so-called impassable forms of stricture are not amenable to this method.

Urethrotomy.—This is the alternative to treatment by dilatation and by it is meant division of a stricture either from within—internal urethrotomy—or from without—external urethrotomy.

Internal urethrotomy.—The cases suitable for internal urethrotomy are essentially penile strictures of the resilient type. These may be dilated fully at one sitting, but at the next they are as narrow as ever and no permanent progress is made by dilatation. Bridle or valvular strictures are also specially suited for treatment by internal urethrotomy as they do not yield to dilatation, and the same remark applies to irritable strictures. External urethrotomy is not a suitable operation for stricture in the penile portion of the urethra unless some complication, such as extravasation of urine, be present. Internal urethrotomy is only possible when the stricture can be dilated to at least the size of a 4 or 5 English previously, so as to allow the passage of the urethrotome.

The operation itself may be performed in several ways. In one the stricture is divided from before backwards; in the other, from behind forwards, and in both cases the incision in the urethra may be made either in the floor or in the roof. Of these methods, we ourselves prefer to divide the stricture from behind forwards and to make the incision in the floor of the urethra, as there is then less likelihood of doing unnecessary damage to the deep urethra and it is more easy to make certain of dividing the whole stricture. It seems advisable also to make the incision in the floor of the urethra because it is there that the main portion of the stricture is found; were the division made in the roof, only healthy mucous membrane might be incised and the stricture itself left untouched.

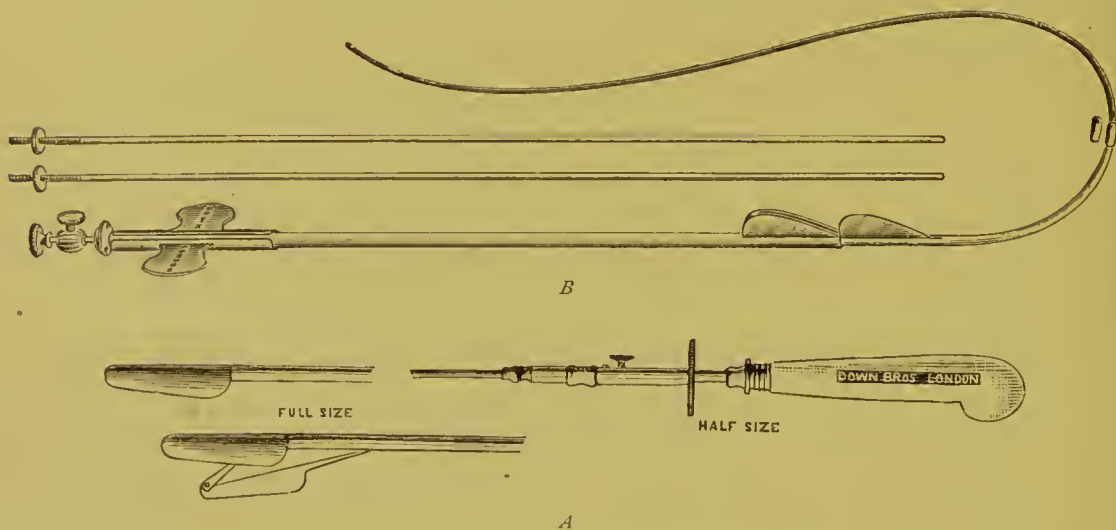


FIG. 91.—TWO TYPES OF URETHROTOME. *A* is Thompson's instrument which we prefer; it cuts from behind forwards and in the floor of the urethra. *B* is Berkeley Hill's; this cuts from before backwards and divides the urethral roof.

The patient should be prepared beforehand, the stricture being dilated sufficiently to admit the urethrotome. Thompson's instrument (see Fig. 91) which we prefer, corresponds to No. 5 English, and therefore the stricture must be dilated up to that either by the intermittent method or by tying in a catheter for a day or two previously; the former method is preferable as the latter may set up urethritis. Another important point is to render the urine as aseptic as possible and this is done by the administration of urinary antiseptics (see p. 274) for a few days previously. The bladder should be washed out regularly with boracic lotion (see p. 282) if there be cystitis. The organ should be emptied immediately before the operation.

The patient is anæsthetised and lies flat upon the back with the legs on the table. The exact limits of the stricture are ascertained by means of the special stricture-finders which accompany Thompson's instrument; these have a shaft graduated similarly to the shaft of the urethrotome and are furnished with a pyramidal head which is passed into the urethra until it rests upon the face of the stricture. The distance from the meatus

is then read off on the graduated scale and the head is passed well through the stricture and withdrawn until its shoulder is felt to hitch against the deep surface of the stricture, when the distance from the meatus is again read off; by subtracting the former measurement from this, the length of the stricture can be ascertained, as well as the distance of the anterior and posterior extremities from the meatus. The urethra should now be well washed out with 1-4000 sublimate solution in a Guyon's syringe (see Fig. 92) and the urethrotome—which should be previously examined to see that it is in perfect order—is lubricated and passed through the stricture with its cutting blade concealed but with the edge directed towards the floor of the urethra. The instrument is passed on until the surgeon knows by the measurements that its bulbous end lies behind the proximal extremity of the stricture. The button is then pressed, the knife is protruded and the urethrotome is gradually and steadily withdrawn, firm pressure being made downwards on the floor of the urethra so as to divide

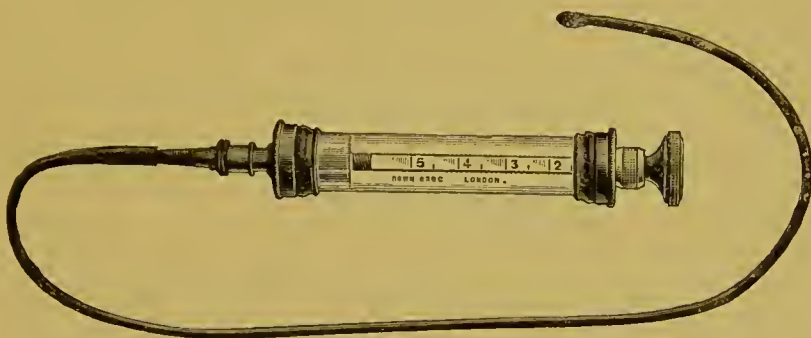


FIG. 92.—GUYON'S URETHRAL SYRINGE. The tube has a backward flow so that the urethra is flushed out from behind forwards.

the stricture fully. The forefinger of the left hand should make light pressure upon the perineum in the neighbourhood of the stricture in order to steady the soft parts and facilitate their division.

When the stricture has been fully divided—as is known by reading the scale upon the shaft of the instrument and also by the relaxation of the pressure on the blade—the latter is sheathed and the instrument is withdrawn. A 7-10 Lister's bougie is now passed and the urethra is rapidly dilated by a series of these instruments up to a No. 14 English. Finally the urethra is again flushed out with 1-4000 sublimate solution and an iodoform bougie (see p. 376) is pushed well down into the region of the incision and left there. It is well not to tie in a catheter as this is apt to set up urethritis from which septic absorption may occur. There is no difficulty whatever in keeping the stricture from contracting if the urethra has been well dilated at the time of the operation and if metal bougies be passed subsequently.

When the patient requires to micturate he may do so spontaneously; there is generally some scalding during the act and it is well therefore to put him in a hot hip-bath or, if he be neurotic, 20 min. of an 8% solution

of eucaine may be injected down the urethra (see p. 402) previously. A full-sized bougie is passed into the bladder at the end of 24-36 hours, taking care to keep the point well in contact with the roof of the urethra; this should be repeated every few days for two or three weeks and then at longer intervals for two or three months. The patient need only be confined to bed for three or four days and during that period should take one of the urinary antiseptics internally (see p. 274).

There are practically no accidents likely to follow this simple operation. Hæmorrhage is rare and is easily controlled by an ice-bag to the perineum; in severe cases a Leiter's tube may be coiled round the penis. It would appear that in many cases there is little tendency for the stricture to contract after division in this manner; but after three months an instrument should be passed monthly for the following six months and then the patient should visit the surgeon two or three times a year in order to see that there is no recurrence. In favourable cases the periods may be lengthened after about two years, but it is always well for the surgeon to pass an instrument at any rate every twelve or eighteen months as a precautionary measure.

External urethrotomy.—Although internal urethrotomy is of great value in a large number of cases, there are some for which it is not suitable. Thus, when the surgeon fails to introduce an instrument through a tight stricture, the only possible procedure is to divide the stricture through an external incision. Apart from these rare cases however there are others in which external urethrotomy should be resorted to, such as dense cartilaginous strictures in the vicinity of the bulb in which the stricture is tortuous and will not yield to dilatation; again external urethrotomy should be preferred for extensive traumatic strictures, while the same may be said of some cases of stricture with retention of urine and those accompanied by perineal fistulæ. Cases accompanied by severe cystitis or by extravasation of urine also require this operation.

At the present time the two forms of external urethrotomy most often practised in England are Syme's and Wheelhouse's. Of these Syme's is the easier, but it can only be done when an instrument can be passed through the stricture and the latter dilated up to the calibre of 3 or 4 English. This is the operation that should be chosen for all cases requiring external urethrotomy in which these requirements can be fulfilled; when it is impossible to get an instrument through the stricture or when the latter cannot be dilated up sufficiently to admit Syme's instrument, Wheelhouse's operation is called for. It is evident therefore that the latter operation has only a limited range, perhaps fortunately, as it is often excessively difficult.

Syme's perineal section.—The stricture is first dilated up to the size of a No. 4 English by the intermittent method if time permits; if the case be urgent however, the patient is anæsthetised and the stricture is rapidly dilated with Lister's bougies until a Syme's staff (see Fig. 93) can be introduced. This staff consists of two portions, the terminal part being about the calibre of a No. 4 English, and joining the handle, which is a No. 12 gauge, by

a well-marked shoulder. On the convexity of the curve of the narrower portion there is a groove which is prolonged upwards a short distance past the shoulder. .

The staff is passed through the stricture until the shoulder hitches against the face of the stricture. The handle is then entrusted to an assistant, and the patient is brought down to the end of the table and put in the lithotomy position. The assistant should hold the staff perfectly vertical and pull the scrotum out of the way. The surgeon shaves and purifies the perineum, and makes a median incision from the root of the scrotum to about an inch in front of the anus. After the superficial structures have been divided, the left forcfinger is introduced into the wound and feels for the staff in the urethra behind the stricture. A few touches of the knife expose the urethra, and then the groove in the narrow portion is felt for, and the point of the knife is slipped over the pulp of the finger until its point perforates the urethra and engages in the groove. The knife is now made to cut from this point upwards, dividing the stricture as it goes, and is carried to the full extent of the groove, that is to say past the shoulder of the staff. If care be taken to incise the urethra behind the stricture, the entire strictured area must be divided if the knife be made to travel forwards as far as the groove extends, because the shoulder of the staff lies upon the face of the stricture.

The handle of the staff may now be depressed and the point of the instrument pushed on into the bladder. If the stricture has been completely divided, there will be no difficulty in doing this; if there is, some fibres of the stricture have escaped division and must be nicked. All bleeding is arrested, the perineal wound is swabbed out with chloride of zinc solution (grs. 40 to the oz.), the staff is withdrawn, and a full-sized gum-elastic catheter bent to the proper urethral curve on a stylet is passed and tied in the bladder, the point of the instrument being kept close along the urethral roof as it is passed.

It is sometimes difficult to pass the catheter into the bladder in this manner as, unless the point be kept closely in contact with the urethral roof, it is very apt to emerge in the perineal wound; this is always likely



FIG. 93.—SYME'S STAFF FOR EXTERNAL URETHROTOMY.

to occur if a soft instrument be used. It is of course a great advantage to tie in a soft instrument as there is less risk of damage to the vesical mucous membrane, and the easiest plan to insure the instrument passing readily is to slip a Teale's gorget (see Fig. 94) along the groove in the staff before the latter is withdrawn. The gorget passes from the perineal wound into the bladder, and serves as a guide along which the point of the catheter is directed when it reaches the perineal opening and tends to emerge from it.

The bladder should never be drained through the perineal wound, and the latter should be left unsutured; its edges fall together as the patient lies in bed and it heals rapidly. If any sutures be used, only a few should be inserted in the anterior part, and enough of the wound should always be left open to insure the free escape of any urine that may find its way alongside the catheter, as otherwise extravasation will occur. The wound is dusted with



FIG. 94.—TEALE'S GORGET FOR EXTERNAL URETHROTOMY. The end is probe-pointed and is slipped along the groove in the staff.

iodoform, and the ordinary cyanide gauze dressings are applied and kept in position by a T-bandage. The catheter is tied in by one of the methods described on p. 345.

The catheter should remain unchanged for three days, when it may be left out. If the stricture has been extensive there is no objection to tying in a second catheter for two days, so as to make sure that the passage remains more or less rigid after the withdrawal of the instrument. After the catheter is withdrawn the patient is allowed to micturate naturally; at first the urine will pass almost entirely by the perineal wound, but in time the amount passing by the urethra will steadily increase, until finally it all passes in the normal direction and the perineal wound heals rapidly, as a rule in about six weeks. A week after the operation the surgeon should pass a full-sized metal instrument into the bladder, and this should be repeated every third day until the wound is healed. The instrument must be passed very gently, the point being kept in close contact with the roof or else it will pass out and open the perineal wound again; a soft instrument should not be passed until the wound has healed. Instruments should be passed at regular intervals after healing is complete; in the first place they should be passed weekly, but the interval may be gradually increased to a fortnight, three weeks, and so on, until, after about a year, the patient need only have an instrument passed once in six months if

the stricture does not show signs of contracting. The results of this operation are very satisfactory; a permanent cure cannot be guaranteed, but any tendency to relapse is easily guarded against by the occasional passage of an instrument.

Wheelhouse's operation.—When the surgeon fails to pass an instrument into the bladder or when the necessary time cannot be devoted to preliminary dilatation of the stricture, Wheelhouse's operation must be employed.

The perineum is shaved and purified as usual and a Wheelhouse's staff (see Fig. 95) is passed down on to the face of the stricture with its grooved surface looking towards the floor. The patient is then placed in the lithotomy position on a table immediately in front of a window in a good light. An assistant takes charge of the handle of the staff and makes the lower end of it prominent in the perineum by depressing the handle, while the surgeon, sitting with his back to the light, cuts down on the end of the staff in the perineum. The exact seat of the incision will depend upon the seat of the stricture, but it usually extends from the mid-point of the perineum forwards for about an inch to an inch and a half; that is to say, the strictures requiring Wheelhouse's operation are usually situated in the bulbous or the membranous portion. The tissues are incised until the urethra is exposed, when the lower end of the staff is felt and the urethra is opened upon the groove in it by a single clean cut extending down to its lower end. It will be noticed that the groove in the staff does not extend quite to the lower end of the instrument. It is important for the success of the operation that the incision in the urethra should not reach quite down to the edge of the stricture as otherwise the guide formed by the floor of the urethra would be lost.

The edges of the slit in the urethra are now seized in fine catch forceps or a thread is passed through them on each side, and the staff is then turned round so that the hook projects through the opening and is pulled up slightly so as to cause the hook to catch in the upper angle of the wound and put it on the stretch. When full retraction is made, a triangular or somewhat lozenge-shaped wound appears in the urethra, at the bottom of which the surgeon looks down upon the face of the stricture. A good plan is to retract the cut edges of the urethra with threads fastened to the skin of the buttock on each side so as to insure steady retraction.



FIG. 95.—WHEELHOUSE'S STAFF FOR EXTERNAL URETHROTOMY.

All oozing is now carefully stopped, and the orifice through the stricture is sought for with a fine probe or a canaliculus director. This is the difficult part of the operation and it is often a matter of the greatest trouble to detect the passage. The best plan is to pass the probe along the roof of the urethra and, if this fails, a useful procedure is to press upon the bladder above the pubes, when the escape of urine through the stricture will give a clue to its orifice. It is therefore well not to have the patient's bladder emptied before the operation. Immediately the orifice is detected, a probe is slipped in along it and kept in position. A powerful light is essential, as well as great patience and careful sponging.

After a probe has been got through the stricture, the rest is comparatively easy. If the probe be a canaliculus director, a fine probe-pointed tenotome or canaliculus knife is passed into its groove and the stricture is slit downwards throughout its whole length until it is large enough to admit a full-sized bougie. If a probe has been used, it is almost equally easy to insinuate a tenotome or a fine canaliculus knife alongside it and slit up the stricture in a similar manner. A Teale's gorget should then be passed into the bladder from the perineal wound and, when all the bleeding has been stopped, a full-sized catheter is passed into the bladder and tied in position. The edges of the perineal wound are allowed to fall together and the dressings and after-treatment are the same as for Syme's operation (see p. 408). If any stitches are inserted they should be merely one or two fine catgut sutures in the urethra and peri-urethral tissues. The skin wound and superficial parts should be left open.

It may be impossible, in spite of every effort, to find a track along which the probe may be passed, or so much time may be consumed in searching for it unsuccessfully that something must be done to terminate the operation speedily. Under these circumstances the best plan is to expose the membranous urethra behind the stricture and to open it; the point of a curved probe may then be passed through the stricture from behind forwards and the latter divided as above. Some surgeons in these cases cut steadily through the cicatricial tissue in the middle line in the hope of striking the urethral canal, and thus make an artificial channel from the penile to the membranous portion along which an instrument is passed into the bladder. This should not be done if it can be avoided, for the urethra may not be hit off and a new track will then be formed in the middle of cicatricial tissue, which is certain to give rise to subsequent trouble. Occasionally however it may be necessary to do this; when this is the case, special care must be taken to prevent contraction during healing. Some surgeons prefer to do a Cock's perineal section (see p. 413) under these circumstances, whilst others open and drain the bladder above the pubes; in both cases the treatment of the stricture is left to a subsequent period.

(2) Of strictures accompanied by complications.—(a) Of strictures complicated by false passages.—When the surgeon is

conscious that he has made a false passage, instrumental treatment should be abandoned for two or three weeks and the patient should be kept in bed for the first two or three days, allowed to micturate spontaneously and an antiseptic such as boracic acid or salol (see p. 274) should be administered by the mouth. Extravasation of urine rarely follows the formation of a false passage except when the latter is behind a stricture or between two. The false passage will generally have closed in about three weeks and then treatment can be begun again. Metal instruments must be used when instrumental treatment is resumed; the urethra should be put fully on the stretch and the instrument used very gently and its point kept well under control.

When the false passage is of some standing, and especially when there is more than one, the surgeon may have the greatest difficulty in passing an instrument; it goes into one false passage after another and it seems impossible to avoid them. The best plan then is to pass a number of fine bougies in succession and, when the first passes into a false passage, to leave it there and pass a second, which will probably either enter the same one if it be large, or another, and to continue this until all the false passages are occupied. Finally another instrument may possibly find its way through the stricture. If this one succeeds, it is held in position and all the others are withdrawn and the surgeon can then either perform an external urethrotomy at once, using the filiform bougie as a guide, or he may tie in the bougie for 24 to 48 hours in order to effect continuous dilatation. There need be no hesitation in tying in a bougie in these cases as, if it be a small instrument, it will not entirely block the stricture and the patient can pass urine beside it. A fine bougie is much better than a fine catheter if soft instruments are being used; the latter is so fine and is so readily blocked that it is of little use for draining off the urine while it is very rare for a stricture to grip a fine bougie so tightly that the patient cannot micturate beside it. When once the stricture has been dilated sufficiently, the surgeon can usually avoid passing the instrument into false passages subsequently as he knows the direction of the canal; moreover, the orifice of the stricture will probably be larger than those of the false passages.

(b) Of strictures accompanied by severe cystitis.—When a patient with a stricture has bad cystitis, the first indication is to provide for free drainage of the bladder. For these cases intermittent dilatation is unsuited, partly because of its slowness, partly because of the risk of infection of any accidental crack of the mucous membrane by the foul urine.

When the stricture is not dense or extensive, the simplest plan is to anæsthetise the patient, dilate the stricture rapidly up to a No. 7 or 8 and then to tie a catheter of that size into the bladder. Through this the urine can escape readily and the bladder may be not only kept drained but may be washed out if necessary, while the presence of the catheter in

the bladder insures dilatation. It is always best to give an anæsthetic, as spasm and straining are done away with and a larger sized instrument may often be passed than would otherwise be possible. Special care must be taken to see that only the eye of the catheter lies in the bladder (see p. 346) as otherwise its end may impinge against the mucous membrane and cause ulceration. Simple cases treated on these lines will be practically cured of cystitis in a few days, when the treatment of the stricture should be continued by intermittent dilatation.

When, however the urine is very foul, it is possible that the mere retention of an instrument in the stricture will give rise to increase in the irritation and under these circumstances external urethrotomy, preferably by Syme's method will give better results, as it will enable a larger-sized instrument to be tied into the bladder and will therefore facilitate drainage. In these bad cases it will probably be well to pass the catheter not through the meatus but through the perineal wound so as to insure the freest possible drainage for a few days. When the condition of the urine improves, the instrument may be passed through the meatus into the bladder and tied in position.

(c) Of strictures complicated by acute epididymitis.—The treatment for epididymitis is described separately (see p. 452). It is well not to attempt to dilate the stricture during the acute stage of the affection. When the acuter symptoms have subsided, either intermittent dilatation or external urethrotomy should be employed.

(d) Of strictures accompanied by retention of urine.—Acute retention of urine, that is to say, complete inability to pass water, may be due to many other causes than stricture of the urethra. Thus it may occur in connection with vesical calculus or spasm of the sphincter vesicæ. Paralysis of the bladder may also give rise to a similar condition, as may enlargement, acute inflammation or abscess of the prostate. In young children the most common cause of acute retention is the impaction of a urethral calculus. These forms have already been dealt with. Retention may occur in any of the three forms of stricture already referred to (see p. 388). We shall here only describe the treatment of retention due to organic stricture; for that caused by congestive and spasmodic stricture see p. 419 *et seq.*

The retention of urine in organic stricture is not entirely due to the narrowness of the stricture; even an extremely tight one will allow some urine to pass. In bad cases however inflammation is a very common accompaniment, more especially if instruments have been roughly employed, and the result of the swelling is to cause complete, though only temporary, blocking of the urethral canal. Hence the retention is usually associated with some more acute or congestive inflammatory condition in the neighbourhood of the stricture.

Treatment.—Unless the distension of the bladder be very urgent, the first measures should be directed to relieving the spasm and congestion;

the best methods of affecting this are to administer suppositories containing morphine (half a grain) and extract of belladonna (a quarter of a grain) and to put the patient in a hot hip-bath. This will frequently result in spontaneous evacuation of the bladder. If however the distension be so great that it is obviously necessary to relieve the patient without delay, the surgeon's first efforts will be directed towards evacuating the bladder. In the first place the instrument employed should be a bougie, either soft or solid according to the predilections of the surgeon; it should not be a catheter. A fine catheter is unduly flexible and the difficulties of getting it through a tight stricture are almost insuperable; moreover, the passage of a very fine catheter is of little use for the purpose of evacuating the bladder, as the flow through it is so slow that it does not keep pace with the secretion of urine and the relief is therefore faulty. The best plan is to obtain a certain amount of dilatation by means of bougies passed under an anæsthetic. For this purpose graduated instruments should be used, either Lister's or some form of tapering whip bougie. If this plan be successful, the stricture may be quickly dilated up to a No. 4 or 6 and then a catheter of this size should be tied into the bladder for 24 hours. This not only evacuates the bladder but produces continuous dilatation and, by the time the instrument is withdrawn, the patient can micturate naturally and the stricture becomes amenable to ordinary treatment, preferably intermittent dilatation.

When however instruments cannot be got in, and this is especially likely to be the case when false passages are present, some other procedure must be adopted. Two methods are at the surgeon's disposal, namely supra-pubic aspiration of the bladder or a perineal section which opens the urethra behind the stricture, the type of which is Cock's operation. The former plan is the simpler, especially if the surgeon be summoned in a hurry at night, as is frequently the case, and has not the necessary appliances, assistants and instruments. Moreover it is frequently found that after a simple aspiration the congestion of the stricture is relieved and the patient can subsequently pass water naturally especially if he be put into a hot bath. It is even well to aspirate the bladder (see p. 421) on two or three occasions before proceeding to more severe measures unless there be some definite reason for preferring to deal radically with the stricture by operation.

Cock's operation.—Cock's perineal section, which was originally introduced for the cure of perineal urinary fistulæ complicating stricture, but which is also very useful for relieving acute retention caused by a very dense and extensive stricture, aims at opening the urethra behind the stricture without touching the latter. As the stricture is always in front of the prostatic urethra, the operation consists in opening the urethra at the junction of the membranous with the prostatic portion at the apex of the prostate. This is not so difficult an operation as it might seem, for the membranous urethra is so dilated in long-standing tight strictures that it

is not easily missed if the knife be kept in the direct line. It is done as follows: The patient is anæsthetised and put in the lithotomy position with the symphysis pubis, the umbilicus and the chin kept rigidly in the same straight line. The left forefinger is introduced into the rectum with its palmar surface upwards and its tip planted firmly against the apex of the prostate. Cock's double-edged knife (see Fig. 96) is then thrust into the middle line of the perineum at a point about half an inch in front of the anus and pushed steadily forwards towards the tip of the finger in the rectum, the long axis of the knife being kept absolutely horizontal. The knife is pushed onwards until the finger in the rectum feels that there is nothing between it and the edge except the rectal wall; the sensation of the loss of resistance as the knife divides the triangular ligament is very characteristic. The urethra will then have been opened as it emerges from the apex of the prostate and if the apex of the gland be incised also, as is frequently the case, it apparently does not matter. The knife is now withdrawn, the left forefinger being kept in position, and

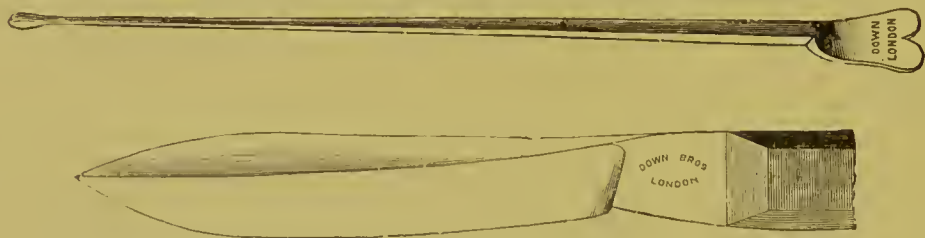


FIG. 96.—DOUBLE-EDGED KNIFE AND PROBE-POINTED DIRECTOR FOR COCK'S PERINEAL SECTION.

the incision in the skin and superficial parts is slightly enlarged upwards and downwards by a sawing movement of the blade as it is withdrawn. A probe-pointed, broad director (see Fig. 96) is now passed through the incision to the apex of the prostate where it enters the urethra and so reaches the bladder. Along this a No. 12 gum-elastic catheter is passed and tied in, so as to drain the bladder through the perineal opening.

Hæmorrhage is slight and can be controlled easily by slight pressure. The wound should be sponged with chloride of zinc solution (grs. 40 to the oz.) and a long india-rubber tube should be attached to the catheter so that the urine is drained off continuously; no attempt is made to deal with the stricture for several days. At the end of a week or ten days, when the condition of the bladder has become good, the congestion about the stricture will probably have diminished enough to allow catheterisation to be effected and then the stricture becomes amenable to the ordinary treatment.

(e) **Of strictures complicated by peri-urethral abscess.**—When the urethra behind the stricture becomes dilated and inflamed, ulceration may occur and infective material may spread down, either through the ducts of the mucous glands or through some slight abrasion in the mucous

membrane, into the peri-urethral tissues and there set up an abscess which in the first instance may be shut off from the urethra. As it increases in size the abscess spreads towards the urethra on the one hand and the skin on the other and generally ends by bursting first into the urethra and afterwards through the skin. The result of this is a perineal urinary fistula. It is not uncommon for other abscesses to form and to give rise to numerous fistulæ, but as a rule there is only one orifice by which the fistulæ communicate with the urethra, whereas there may be several openings on the surface. It is common for these peri-urethral abscesses to commence in suppuration in Cowper's glands.

When the abscess bursts into the urethra early, urine will find its way into the abscess cavity and the condition is then sometimes spoken of as a urinary abscess. This gives rise to rapid increase in the inflammatory condition and, if only a small quantity of urine finds its way into the abscess cavity, a perineal urinary fistula will form when the abscess makes its way through the skin. Sometimes however the opening into the abscess from the urethra is wide and urine enters freely. When the patient micturates, the pressure in the abscess is very great if the stricture be tight, and the wall may give way and sudden extravasation of urine (see p. 418) may take place.

Peri-urethral abscesses usually occur in the perineum below or behind the urethra and cause much pain. There are generally rigors and all the symptoms of acute inflammation. When the abscess bursts into the urethra pus flows from the meatus, sometimes independently of micturition, sometimes only when the patient urinates, if the stricture be very tight.

Treatment.—The earlier these abscesses are opened from the outside the better, and if this can be done and the stricture at the same time dilated the chances are that no urinary fistula will form. In some cases however the abscess is situated quite close to the urethra, the wall of which is much thinned, and, even though the abscess be incised before it has burst into the urethra, the thinned mucous membrane will give way subsequently and a urinary fistula will follow. On the other hand the abscess may burst into the urethra almost as soon as its existence is ascertained. It should be a definite rule that any brawny tender swelling in the perineum in connection with a stricture should lead the surgeon to incise it freely at once. If an abscess be opened in this manner, a large drainage tube should be inserted and nothing further need be done immediately, provided that the patient can pass water fairly freely. Then after a lapse of a few days a Syme's external urethrotomy (see p. 406) should be performed. If on the other hand the stricture be very narrow, it may be better to perform an external urethrotomy at the time that the abscess in the perineum is opened.

(f) **Of strictures complicated by perineal fistulæ.**—The manner in which perineal fistulæ occur in connection with a peri-urethral abscess has just been mentioned. Fistulæ may also follow extravasation of urine

(see p. 418) and are then much more serious, as they are associated with fairly extensive loss of tissue, so that, instead of a small fistulous orifice into the urethra, as is usually the case when a fistula follows a peri-urethral abscess, there may be a large defect in the urethral wall. Other causes of perineal urinary fistulæ are external urethrotomy and injuries of various kinds. Tuberculous prostatic abscess occasionally ends in fistulæ, as does also carcinoma.

The fistulæ may be situated either in the penile portion of the urethra or further back in the perineum and may be divided into two great groups: (a) Those in which the communication is between the skin and the urethra and (b) Those in which the communication is between the urethra and the rectum, and possibly also the skin. This latter condition either follows an operation such as lithotomy accompanied by wound of the rectum, or may occur in connection with prostatic abscesses which have burst into the rectum.

Treatment.—The prospect of treating these cases successfully varies according to the situation and nature of the fistula. In *penile fistulæ*, which are fortunately rare, there is often great difficulty in obtaining closure, as the mischief is probably caused by sloughing of the urethra. When the fistula is primarily due to stricture of the urethra, the treatment will be to dilate the stricture first and, when that has been done, the fistula may close rapidly; in many cases however it will not do so, as epithelium has spread down it, and a plastic operation will be necessary. The edges of the fistula must then be pared and, when there is much loss of substance, it may be necessary in addition to raise a flap to cover the opening. This will be especially called for when the fistula has followed extensive extravasation of urine and there is consequently considerable loss of the urethral wall. Many operations have been devised for the purpose, most of which are modelled upon the lines of the operations for hypospadias (see Chap. XXXVI.A). When the loss of tissue is not great, a flap may be turned in over a catheter tied into the bladder with its raw surface forming the new floor of the urethra. In other cases two superimposed flaps may be necessary, the cutaneous surface of the deeper one forming the floor of the urethra. No particular rules can be laid down; the surgeon will have to devise the operation for himself in many cases. If union fails at any point, a smaller fistula will be left and this may sometimes be made to unite by touching the defect with a hot wire or a cautery point, or a second plastic operation may be needed, in which case the edges will be pared and brought together by sutures.

When the fistula is in the perineum and is connected with a stricture in front of the bulb, there is no chance of it healing until the stricture has been cured. When it follows a peri-urethral abscess, dilatation of the stricture will often suffice and therefore the treatment should be directed first to this point. As the stricture becomes fully dilated less urine passes through the fistula until finally it heals.

Sometimes however dilatation may fail even though carried to its full extent, as the tissues may be very rigid or the direction of the fistulous opening may be such that the urine continues to escape through it. Here the best plan is to perform a Syme's urethrotomy, dividing the strictures thoroughly and enlarging and scraping the fistula; the essential point in treatment is to deal with the stricture thoroughly by external urethrotomy.

By one of these means the fistulæ will generally be got to heal, except when they have followed extensive sloughing of the tissues after extravasation of urine. Here some form of plastic operation on lines somewhat similar to those for hypospadias (see Chap. XXXVI. A) may be called for and in them it will generally be necessary to drain the bladder, so as to prevent urine passing over the wound; even if a catheter be tied in, urine is almost certain to escape beside it and lead to failure of the operation. Under these circumstances supra-pubic drainage (see p. 289) may be established and the perineal condition treated by an external urethrotomy, dividing the stricture freely, paring raw surfaces or turning in flaps according to the circumstances of the case.

A very difficult type of case to treat is *a communication between the rectum and the urethra* with or without a perineal opening. As a rule the communication with the rectum is just above the sphincter and, on the one hand, the liquid fæces are guided into the urethra while, on the other, urine escapes into the rectum; if there be a perineal opening both may come through it. The wall of the fistula soon becomes lined with epithelium and there is no possibility of spontaneous healing, so that a comparatively elaborate operation, separating the urethra from the rectum and then suturing each canal separately after paring the edges of the opening into it, must be undertaken for its cure. This is best done through a crescentic incision in front of the anus which is deepened so as to reach the interval between the urethra and the rectum, the former structure being defined by a sound passed into the bladder. The rectum should be pulled well backwards. The fistulous tract must be divided as it is defined, leaving as much of the mucous membrane as possible on the urethral side, as the latter is most likely to be narrowed by a plastic operation, whereas slight narrowing of the rectum is not of much importance. The opening into the rectum is inverted and closed by sutures inserted on Lembert's plan, and that in the urethra is similarly treated. A little gauze is packed between the two points until the wound is granulating, when the parts are allowed to come together and healing by granulation occurs rapidly. The greatest care must be taken to prevent urine passing into the wound and, when the orifice of communication is extensive, it may be advisable to carry out supra-pubic drainage for a time. The sphincter ani must be freely dilated (see p. 6) so that there shall be no obstacle to the exit of fæces. It may possibly be necessary to divide the sphincter in order to insure incontinence of fæces, but this can be repaired subsequently. If a stricture of the urethra exists it must be treated in the ordinary manner.

(g) **Of strictures complicated by extravasation of urine.**—Extravasation of urine following a peri-urethral abscess has already been described (see p. 415). Many cases however occur without any previous urinary abscess, the wall of the urethra becoming thinned and giving way either as the result of some local injury, such as a blow, or of excessive straining on attempting to pass water; the urine passes through the rent into the peri-urethral tissues. In both these cases the opening in the urethra will be in front of the triangular ligament, but the accident may occur behind that structure when it is associated with urinary abscess. The urine however quickly finds its way in front of the triangular ligament where it forms a swelling limited by the attachments of the deep layer of the superficial fascia; this is attached to the lower margin of the triangular ligament behind and to the rami of the pubes on either side so that the urine does not extend beyond the middle point of the perineum behind but passes forwards into the scrotum along the penis and up on to the anterior abdominal wall, being prevented from passing down into the thighs by the attachment of the fascia to Poupart's ligament. Occasionally extravasation occurring in connection with a urinary abscess deep to the triangular ligament may pass backwards and form an ischio-rectal abscess. Sometimes it passes up between the bladder and the posterior surface of the symphysis and forms a brawny swelling in the hypogastric region.

Symptoms.—At the moment of extravasation there is often great relief, as the patient gets rid of a certain quantity of urine from the distended bladder, although this passes into the tissues and not through the meatus. The accident is usually accompanied by a burning pain in the perineum, and a swelling about the scrotum and penis is noticed almost immediately if much urine be extravasated. The extravasated urine, which is generally very septic, sets up symptoms of acute cellulitis within an hour or two, the pain increases, the patient has a high temperature, probably with rigors, the perineum, scrotum and penis become immensely swollen and, unless immediate relief be afforded, sloughing occurs and death results from septic absorption.

Treatment.—Free incision and immediate evacuation of the extravasated urine must be effected as soon as the diagnosis is made. No palliative treatment is possible; it can only result in widespread sloughing of the wall of the urethra, the deep tissues and the skin, and usually in the death of the patient. Free incisions must be made into every infiltrated area, and the incisions must go right down into the tissues so affected. Usually a long, free median incision with a lateral incision on each side, extending from the front of the anus right up into the scrotum, are required, together with incisions along either side of the dorsum of the penis and free incisions into the abdominal wall. If this be done quite early after the extravasation, the tissues will not be very severely damaged and recovery may occur with very little sloughing. If several hours be allowed to elapse however the tissues will be foul, and there will be extensive sloughing.

A free exit for the urine from the bladder must also be established, and an immediate external urethrotomy should be done if the patient's condition be at all good. If however the patient be very ill, the opening in the urethra behind the stricture should be identified if possible, and should be enlarged if necessary to allow of the free passage of urine. In these gangrenous cases a catheter should not be tied in, as cystitis may be set up and may lead to the death of the patient, whereas increasing the opening in the urethra allows the patient to micturate readily through the perineal wound. Even when an external urethrotomy has been done, an instrument should not be tied in, but the wound should be left open until all the sloughs have separated.

In these cases some surgeons prefer to do Cock's perineal section (see p. 413) and to open the urethra freely behind the stricture. This need only be done however when it is impossible to identify the opening through which the extravasation has taken place.

The wounds should be left open, powdered with iodoform and stuffed with cyanide gauze. Large boracic fomentations should be applied outside and must be changed frequently. The patient will require tonic treatment until the sloughs have separated and the wounds are granulating. When the sloughing is extensive it is an excellent plan to keep the patient permanently in a warm bath until the sloughs have separated, keeping the water changed frequently and the temperature maintained.

SPASMODIC STRICTURE.

Complete retention of urine may occur without any organic change in the coats of the urethra and may be caused by reflex spasm of the extrinsic muscles of the urethra from irritation elsewhere; the membranous urethra is practically always affected. The condition is frequent after various operations, such as those about the anus, perineum or genital organs. It may also occur after operations elsewhere, especially in hysterical subjects, and spasmodic retention of urine may occur in women without any apparent cause.

TREATMENT.—When the condition is met with after an operation, the treatment is two-fold; on the one hand it is directed to the relief of the retention itself and on the other to attempts to allay the spasm. The best way of allaying spasm is to apply hot fomentations to the pubes and the perineum or, better still, to put the patient in a hot bath and give him a rectal suppository of morphine. In many cases following an operation however it is neither possible nor advisable to place the patient in a hot bath, nor is it desirable to wait for the effects of morphine, and there is no objection to relieving the retention at once by means of a catheter. When however the cause is hysteria, it is well to employ the other remedies first, and to refrain from using a catheter as long as possible; should it be necessary to resort to it, a red rubber Jacques' catheter, carefully

sterilised by boiling and passed with all the precautions as to disinfection already recommended (see p. 336), should be used. A cystitis set up in a subject of simple spasm of the urethra is a very serious matter, as the cystitis is apt to be aggravated by the co-existing spasm. The instrument should be a fairly large one (8-10 English) and, as gentle pressure may be required to overcome the spasm, a black olivary catheter may have to be employed; with a little patience however Jacques' instrument can generally be passed.

As a rule there is no difficulty in passing the catheter as far as the membranous urethra, but when it reaches the opening in the triangular ligament it becomes arrested by the spasm, which is probably increased for the moment by the contact of the point of the instrument. Steady pressure should be kept up against the obstruction without moving the catheter, and in the majority of cases the spasm will relax in a few minutes and the instrument will pass into the bladder. Occasionally the catheter becomes arrested again in the prostatic portion, and then the spasm is about the neck of the bladder; in some cases the spasm appears to be entirely in this situation. Steady pressure will usually succeed in passing an instrument whereas twisting it is apt to increase the spasm.

A rectal suppository containing morphine and belladonna should be administered after the bladder has been evacuated, hot fomentations should be applied over the pubes and perineum, and the patient should be given hot drinks and kept in bed; he is usually able to pass water the following morning. If this be not the case, the bladder should be evacuated with a catheter three times a day until the spasmodic condition has passed off; with few exceptions the spasm does not last longer than the second or third day. Some patients however are very nervous and cannot pass water after an operation until they are allowed to stand up or at any rate to micturate when upon the hands and knees. The period at which this will be allowed is determined by the nature of the operation.

CONGESTIVE STRICTURE.

The typical example of this condition is acute retention of urine occurring during the course of gonorrhœa; it is essentially a combination of congestion of the mucous membrane with spasm of the extrinsic muscles of the urethra. The swollen mucous membrane offers a certain amount of impediment to the passage of urine and the obstruction is completed by the spasm which is due to the irritation of the inflammation. As a rule the spasm subsides easily if the congestive condition can be got rid of.

TREATMENT.—Here the passage of an instrument along the urethra is a serious matter and should be avoided if possible; in the first place it tends to increase the irritation and, owing to the congested condition of the mucous membrane, hæmorrhage may be set up. The pain and spasm are increased rather than diminished by it, and moreover in gonorrhœa the

gonococci are almost certain to be carried back and deposited in the neighbourhood of the prostate or the bladder itself, so that acute prostatitis or cystitis may be set up. Therefore the first efforts in treatment must be directed to encouraging the patient to micturate spontaneously, and this is best done by giving a suppository containing half a grain of morphine with a quarter of a grain of extract of belladonna, and putting the patient in a hot bath in which he should stay until he feels faint; he is encouraged to pass water in the bath. The bowels should be freely cleared out previously by five grains of calomel.

If this fails, the bladder must be relieved by some mechanical means, and we prefer *supra-pubic aspiration* which possesses no risk, whereas the dangers of passing a catheter have already been pointed out. The bladder is distended, so that the peritoneum is lifted well up from the symphysis and there is no risk of puncturing it, while, if a fine aspirating needle be used, there is no risk of extravasation of urine into the pre-vesical space.

The operation is simple and is done as follows. The parts are shaved and disinfected in the usual manner and a fine aspirating needle is thrust through a small nick in the skin made with a lancet immediately above the symphysis pubis, and is directed backwards and slightly downwards; the sudden cessation of resistance will at once show when the needle has reached the bladder, and urine will issue directly. A fine aspirator should be employed and it should be provided with an inner tube so as to avoid lacerating the opposite wall of the bladder as the organ empties; it is well to place the forefinger upon the needle about an inch from its point in order to prevent it being thrust too deeply into the structures in the first instance.

The first portion of urine will escape without aspiration, but the last should be withdrawn by attaching the bottle of the aspirator. The needle is then withdrawn,¹ a collodion dressing is applied to the small puncture and the patient is put back to bed with hot fomentations to the perineum and hypogastric region, and a morphine and belladonna suppository is administered. The congestion will often pass off in a few hours and the next time the bladder becomes full the patient may be able to empty it in the natural manner. There is no objection however to performing aspiration again if necessary and in a short time the congestive condition will disappear.

¹ A drachm of boracic lotion may be syringed through the needle by means of a hypodermic syringe immediately before withdrawal. This clears the needle of urine, and none is therefore drawn through the pre-vesical cellular tissue. Not more than a drachm should be used.

SECTION IV.—AFFECTIONS OF THE PENIS, TESTES AND SCROTUM.

CHAPTER XLI.

PHIMOSIS AND PARAPHIMOSIS.

PHIMOSIS.

By the term phimosis is meant an inability to draw the prepuce back over the corona glandis. The condition may be congenital or acquired and varies in degree from a mere pinhole to just enough constriction to prevent the entire glans being exposed.

CONGENITAL PHIMOSIS.—In the congenital form the chief trouble is at the preputial ring, *i.e.* the junction of the mucous and cutaneous surfaces, and there are moreover practically always adhesions between the prepuce and the glans, which may be firm and dense, so that their separation leaves a raw surface, or may be so slight that the two structures may be peeled apart without causing any bleeding. In some cases the difficulty in retracting the prepuce is entirely due to these adhesions and not to too narrow a preputial orifice. In congenital phimosis the prepuce is nearly always unduly long, but not invariably so.

The condition is accompanied by an accumulation of smegma beneath the prepuce which, although it may give rise to some slight irritation from its mere presence, does not necessarily cause balanitis unless pyogenic organisms find entry. This however is almost certain to occur as the child grows older, and then balanitis of a very severe type may set in. There may be difficulty in micturition when the preputial orifice is very narrow and this may lead to undue frequency which in bad cases may amount almost to incontinence. There may also be straining on micturition which predisposes to hernia and may produce prolapse of the rectum. The reflex irritation due to the adhesions may be very marked and is a frequent cause of masturbation as the child gets older, whilst in adult life very

serious results may follow the occurrence of venereal disease under these conditions. Finally, the constant irritation from the retained secretion may be a powerful predisposing cause of epithelioma of the penis. When the preputial orifice is very narrow there may be severe backward pressure in the urinary passages from obstruction to micturition.

It is important to remember that this condition may disappear in time. Hence, although circumcision is a very valuable method of treatment, it is not absolutely essential in all cases, and, when the preputial orifice is not so tight as to interfere with micturition in any way and when there are no other symptoms present and the parents object to circumcision, the condition may be left, in the hope that it may disappear in time.

ACQUIRED PHIMOSIS.—The most common cause of this is inflammation or ulceration beneath an unduly long prepuce, and a common factor is frequently recurring balanitis which causes thickening of the prepuce and narrowing of its orifice. A similar condition may follow cicatrisation of multiple soft chancres about the preputial ring. Phimosis may also result from a faulty circumcision in which the prepuce has been cut unduly long and has not been slit up upon the dorsum.

Treatment.—(a) **Of congenital phimosis.**—When the trouble is merely due to adhesion of the prepuce to the glans without undue elongation of the former or narrowing of its orifice, it suffices to separate the adhesions so as to allow the prepuce to be retracted. The best plan is to insinuate the eyed end of a probe between the prepuce and the glans as far back as possible in the first instance and to sweep this around the glans, so as to commence the separation of the adhesions. The prepuce is then retracted and, as the glans appears, it is steadied with one hand whilst the prepuce is peeled right back with the thumb of the other. As the prepuce is fully withdrawn the small masses of smegma are exposed behind the corona, and these should be removed by the gentle application of swabs wet with warm boracic lotion. The glans must be completely exposed, as particular care must be taken to remove all the smegma in the neighbourhood of the frenum. There is no need for an anæsthetic as a rule and there is no bleeding unless the adhesions be dense. The manipulations are a little painful while they last, but the pain ceases immediately the prepuce is drawn forward again. If the retraction of the prepuce has been effected without the occurrence of any bleeding, all that is necessary is to smear the glans well over with vaseline and then to draw the prepuce forward, and the nurse should be instructed to go through a similar procedure every morning and evening when the child is washed, and to see that the glans is kept clean and free from adhesion. It is important to caution her not to keep the prepuce withdrawn for any length of time, as otherwise swelling may occur and there may be difficulty in pulling it forward again; in other words, paraphimosis may occur. In the course of a week or two there is no likelihood of the adhesions recurring if the prepuce be retracted daily in this manner, and the cure is complete.

If, however, retraction of the prepuce gives rise to a considerable raw surface, it is best on the whole to proceed to circumcision because balanitis must otherwise result and the treatment will be painful and probably imperfect. Some surgeons strongly object to circumcision and prefer to dilate the narrowed preputial orifice repeatedly with a special instrument like a glove-stretcher until the tendency to contraction has been completely overcome. This method however is unsatisfactory and if employed must be done so gently as to avoid any cracking of the mucous membrane which would give rise to inflammation and cicatricial contraction. There is no valid objection to circumcision and indeed it possesses great advantages, especially as a precautionary measure against masturbation. In all cases therefore in which the prepuce cannot be fully retracted and in those in which retraction is accompanied by much bleeding from the separation of adhesions, it is best to perform circumcision.

Circumcision.—This operation may be performed in various ways; the method that we prefer is as follows. The preputial orifice is seized on each side of the middle line in catch forceps, pulled well forward and put upon the stretch. One blade of a pair of blunt-pointed scissors is insinuated between the prepuce and the glans and the whole thickness of the prepuce is slit up in the middle line of the dorsum as far as the corona (see Fig. 97, *A*). It is needless to say that care must be taken to see that the blade of the scissors does not injure the glans or pass into the meatus. It is sufficient to mention the risk of such an occurrence, which should not happen with the exercise of ordinary care. As soon as the first incision has been made, the glans is seen and can be entirely freed from the adherent prepuce right back beyond the corona, and the mucous membrane and the skin must be slit up well beyond this point. When the prepuce has been peeled back on each side and all smegma removed, a third pair of forceps is placed upon the frenum and the redundant prepuce is cut away on each side (see Fig. 97, *B*), with scissors. Enough mucous membrane must be left to overlap the corona comfortably and, if the parts be divided as shown in the figure, the frenum itself will not be divided and therefore the unsightly œdematous button which takes a long time to disappear and which is so often seen after this operation will be avoided. The incision usually runs about a quarter of an inch from the corona and this leaves sufficient prepuce to cover the latter easily. Any bleeding points are twisted; it is very important to stop all hæmorrhage before proceeding to suture the cutaneous to the mucous surface, as otherwise bleeding into the substance of the prepuce may occur and will lead to an unsightly and troublesome hæmatoma. Fine catgut sutures are now made to approximate the cutaneous and mucous surfaces carefully throughout, so as to secure primary union everywhere.

After-treatment.—When the separation of the prepuce from the glans does not give rise to a raw surface, the simplest plan is to dry the line of incision, lay a little salicylic wool over it and fix it in position with flexile

collodion which dries quickly and may be left for about a week. The child should then be put in a bath about a quarter of an hour before the surgeon's visit, and the dressing can be easily peeled off and the stitches removed. Any raw surface remaining may have a smaller fresh dressing applied to it.

When however the surface of the glans is left raw, a better method is to wind a strip of wet boracic lint around the line of union, while outside

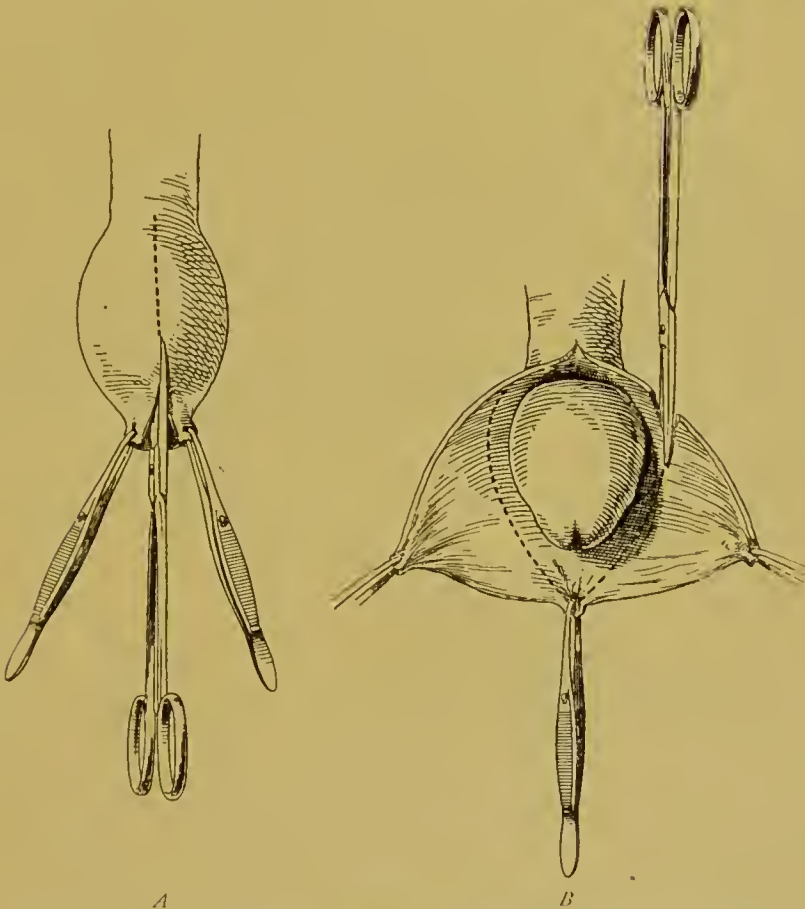


FIG. 97.—CIRCUMCISION. This is the method recommended in the text. *A* shows how the preputial orifice is put on the stretch as the prepuce is slit up; *B* shows how both layers of the prepuce are pared away together along the dotted lines.

this a large layer of wet boracic lint is applied so as to cover the whole penis and scrotum and this is covered with oiled silk or jaconet and kept in position by a T-bandage. The mackintosh and the larger pieces of lint are removed when the child passes water, and the glans is douched with warm boracic lotion. The organ need not be touched at all; the lotion is poured over the glans from a little height and washes the parts clean. Fresh outer dressings are then applied, and this is repeated for a few days until the parts are healed. After the first three days the inner layer of boracic lint may be soaked off and a narrow strip of boracic ointment on muslin applied in its place. The stitches may be removed on the fourth or fifth

day. The child should be kept in bed for the first three or four days, as otherwise the friction of the clothes against the wound may cause pain. Until everything is permanently healed the parts should be surrounded with a mass of salicylic wool kept in place with a T-bandage when the child gets up.

Another method of performing circumcision very commonly employed is to take a pair of dressing forceps and place them upon the organ just in front of and parallel with the corona glandis when the penis is lying in its normal condition. The blades of the forceps are then very gently closed (see Fig. 98, I.), the glans penis being allowed to slip backwards as

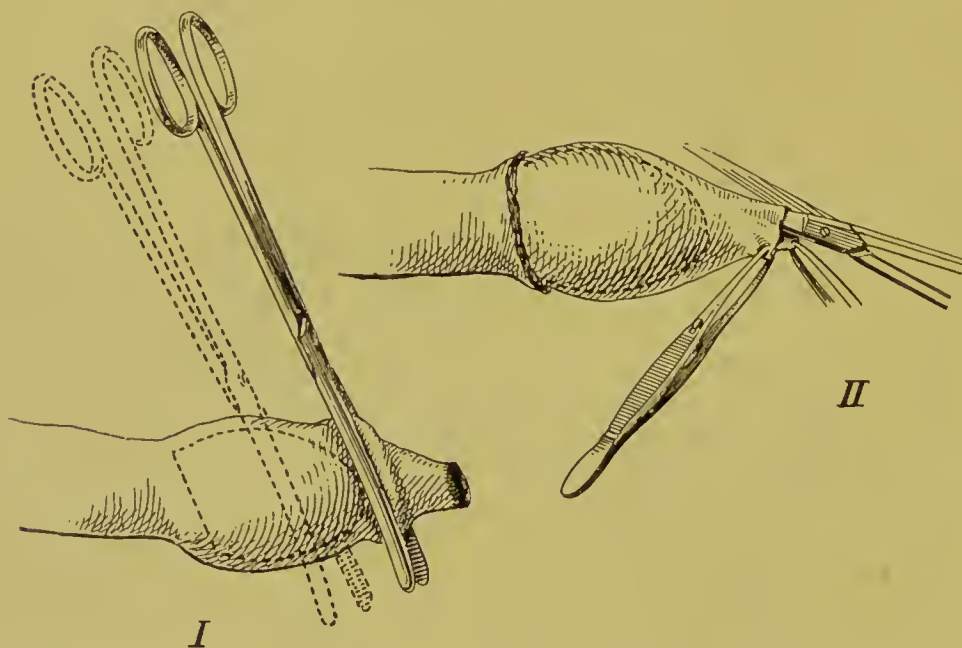


FIG. 98.—ANOTHER METHOD OF PERFORMING CIRCUMCISION. I. illustrates the method of estimating the amount of prepuce to be removed. The forceps are applied to the flaccid organ in the position of the dotted outline, *i.e.* just in front of the greatest transverse diameter of the glans. By gently closing their blades the glans slips back and the portion of the prepuce to be removed remains in front. II. shows how the mucous surface of the prepuce is slit up after the cutaneous portion has been removed and the cut margin has retracted behind the corona glandis.

this is done, so that finally the forceps are closed upon the redundant prepuce which lies in front of the glans and is pulled somewhat forwards. The portion projecting beyond the forceps is quickly sliced off with a sharp knife and the forceps are removed. The latter must not grip the prepuce too tightly as otherwise bruising may occur and will interfere with healing. This incision removes the cutaneous portion of the prepuce but does not cut away enough of the mucous membrane, which must therefore be slit up in the middle line of the dorsum right back beyond the corona glandis in a manner similar to that in which the prepuce is slit up in the previous operation (see Fig. 98, II.). The adhesions are separated as before, and the redundant mucous surface of the prepuce is clipped away along the

same lines as in the previous case, when the bleeding is stopped and the wound is sutured as before. The after-treatment is similar to that already described.

In doing this operation it is important to cut the mucous surface of the prepuce obliquely by the **V**-shaped incision shown in Fig. 97, *B*. If it be pared off too close, a very troublesome triangular surface will be left below the frenum which takes a considerable time to heal and is very painful during the process, while it leaves a sensitive, ugly button which takes a long time to become slightly.

(b) **Of acquired phimosis.**—When operation is required for contraction after the healing of a venereal sore or after balanitis, it may if desired be performed as above described; in these cases comparatively little of the prepuce need be removed. When however the patient does not desire complete circumcision, a very useful method is to slit up the prepuce in the middle line of the dorsum to a sufficient extent to allow the glans to be thoroughly uncovered and then to unite the mucous to the cutaneous surfaces along the line of incision so as to convert it into a **V**-shaped opening which enlarges the preputial ring. As healing progresses this **V**-shaped notch gradually becomes opened out, until finally it disappears entirely, and in place of it there is a preputial orifice of sufficient size. Ordinary circumcision however should be preferred to this operation if it be found that there are extensive adhesions between the glans and the prepuce.

PARAPHIMOSIS.

This is a common complication of phimosis and in it there is inability to draw forward the prepuce which has been retracted over the glans. When a tight prepuce has been kept retracted for a short time the constriction exerted by the preputial ring leads to swelling of the mucous membrane in front of it accompanied by considerable œdema which prevents the prepuce being drawn forwards again. If this condition of affairs be allowed to remain, the swelling increases and there will be ulceration of the mucous membrane along the line where it is constricted by the preputial orifice.

The appearance of a typical case of paraphimosis is quite characteristic. Immediately behind the corona glandis there is a fold of œdematous mucous membrane, which is often so distended with fluid as to be quite translucent. Behind this is a deep groove, at the bottom of which is seen the constricting band formed by the preputial ring which will show a more or less deeply ulcerated surface corresponding to the length of time that the paraphimosis has lasted.

Treatment.—The indication is to draw the prepuce forwards, and this can be done fairly easily when the affection has not lasted long enough to produce much œdema. The patient lies upon the back upon a couch, and the fore- and middle fingers of each hand are placed one on either side

of the organ behind the constriction (see Fig. 99). The thumbs are placed over the glans and gradually knead that structure back through the preputial

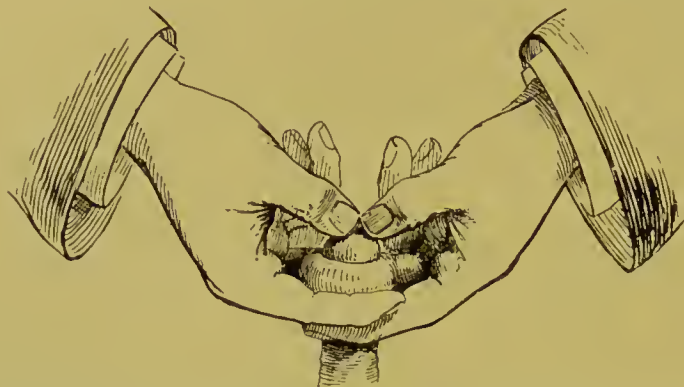


FIG. 99.—REDUCTION OF A PARAPHIMOSIS. This shows the position of the fingers behind the œdematous prepuce and also the way in which the thumbs are used to knead the glans back through the constriction.

opening, which is pulled forward by the fingers behind it. If there be considerable œdema, a few punctures may be made with a fine tenotomy knife

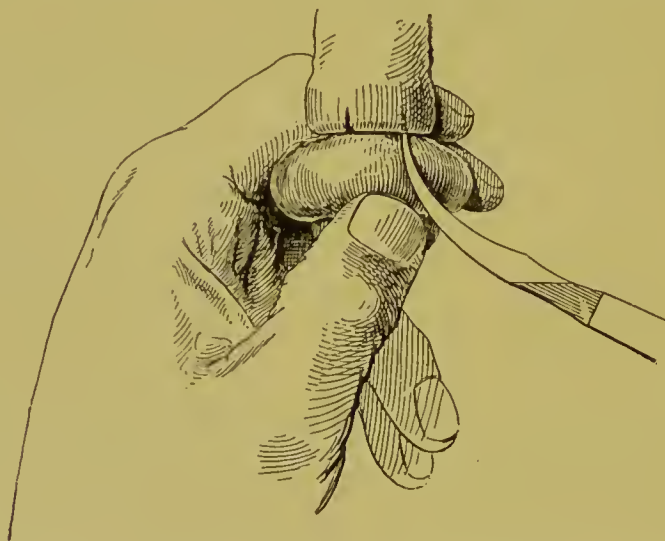


FIG. 100.—HOW TO DIVIDE THE CONSTRICTION IN PARAPHIMOSIS. The glans is well bent down so as to expose the constricting band, which is then nicked in two places, as shown in the figure.

in the œdematous fold in front of the constriction and the fluid allowed to escape.¹ This procedure is very painful and may require an anæsthetic.

¹A manœuvre recommended by the late Mr. Arthur Durham may be useful in these cases. The penis is encircled from the apex of the glans to the root with a bandage of tape or narrow elastic webbing. This is applied especially firmly about the glans and the œdematous fold and is designed to drive out the fluid from the swollen end of the organ. It is kept on for two or three minutes, when it is suddenly withdrawn and the procedure recommended above for the reduction of the paraphimosis is carried out as rapidly as possible. The compression diminishes the size of the parts and in this way the glans may be rapidly thrust back through the preputial ring.

When the swelling is very marked, and especially when ulceration has occurred, this plan will not succeed and the constricting band must be divided under an anæsthetic. The preputial ring is exposed by flexing the glans downwards (see Fig. 100), a sharp-pointed curved bistoury is introduced beneath it on either side of the middle line and the constriction is freely nicked. The incision should go through the skin and subcutaneous tissues and the prepuce can then be drawn forward easily with a little manipulation. The reason for making the incision on either side of the middle line is to avoid the dorsal vein of the penis.

After reduction the question of circumcision will arise, as the condition is very apt to recur, especially in children, and when the constriction has been so tight that there is ulceration, circumcision is certainly called for, as otherwise contraction will follow healing of the ulceration and the preputial ring will be tighter than before.

At the same time it is not always advisable to perform circumcision immediately after the reduction of a paraphimosis. In adults the accident frequently happens as a result of withdrawing the prepuce in a case of balanitis in order to cleanse the glans and, if circumcision were done here before the balanitis is cured, serious septic mischief might result. In these cases therefore it will be best to wait for a few days until the balanitis has disappeared and then to perform circumcision.

CHAPTER XLII.

TRAUMATIC AND INFLAMMATORY AFFECTIONS OF THE PENIS.

INJURIES.

THESE are comparatively rare and take the form of contusions, punctured or incised wounds, hæmatomata or dislocation of the organ; the penis may also be strangulated by a ring passed over it or a ligature tied round it. Rupture or so-called "fracture" of the penis may occur and is usually caused by damage to the sheath of the corpora cavernosa from a blow upon the erect organ. The importance of this injury is that erection may be interfered with subsequently by cicatricial contraction. By the term "dislocation of the penis" is meant the rare injury in which the erectile portion of the organ has been dislocated from the skin and subcutaneous tissues and has found its way into the cellular tissue elsewhere.

INFLAMMATORY AFFECTIONS.

BALANITIS.—The mucous surface of the prepuce is readily infected by pyogenic organisms, when balanitis, characterised by a purulent discharge between the glans and the prepuce, is set up. This may be due to the irritation of retained secretion beneath a long prepuce, to dirt, to masturbation, to venereal or herpetic ulceration, or, most frequently, to gonorrhœa. In most cases the surface of the glans is affected as well as that of the prepuce and the term postho-balanitis has been applied to this condition.

The prepuce becomes swollen and tender, and its orifice may be so narrowed that a condition of acquired phimosis is present. Micturition is painful owing to the irritation caused by urine finding its way between the glans and the prepuce. The surface of the glans when exposed is congested and has lost its superficial epithelium in places and sometimes is ulcerated. When the prepuce cannot be drawn back, the retention of discharge beneath it may give rise to extensive ulceration ending in gangrene

of the prepuce, or even in general septic infection commencing as a lymphangitis; this is most likely to occur when the affection is due to venereal sores.

Treatment.—The treatment is easy when it is possible to draw the prepuce back; all that is necessary is to bathe the parts freely with warm boracic or 1-6000 sublimate lotion, after which boracic lint is tucked between the glans and the prepuce so as to prevent the opposed surfaces from coming into contact and the prepuce is drawn forwards. If this be done several times a day the inflammation will subside in a few days.

When however the prepuce cannot be retracted, the secretion beneath it must be removed by frequent copious syringing with warm boracic lotion. If the prepuce be swollen and lymphangitis be present, the entire organ should also be wrapped up in lint saturated with lead lotion. Under this treatment the condition will generally subside, and then the question of circumcision must be considered if the prepuce be unduly narrow or long and if the attacks of balanitis be of frequent occurrence. At any rate the preputial orifice should be slit up (see p. 427).

When the inflammation persists or increases in spite of the above treatment, it is necessary to expose the glans freely, so as to enable the parts to be cleansed. This should be done by a median dorsal incision, but it is better not to perform circumcision, as the wound is septic and widespread sloughing might occur. The glans is thoroughly exposed and cleansed after the prepuce has been slit up, and boracic lint is inserted between the two; finally the whole organ is wrapped up in a large boracic fomentation which must be frequently renewed.

HERPES PROGENITALIS.—Herpetic eruptions on the penis and prepuce are not uncommon; they are often associated with gout and also occasionally with stricture or with granular patches in the urethra. They may cause much distress, as the patient is very likely to mistake them for venereal sores.

The condition begins with itching beneath the prepuce, on retracting which a typical herpetic patch is found. The vesicles run together and form a pustule which bursts and leaves a small ulcer which is sometimes difficult to distinguish from a soft chancre; the condition may not be noticed until it has lasted for some time, when balanitis is set up and the ulceration may be considerable.

Treatment.—The condition readily clears up under the treatment for balanitis (*vide supra*).

PHAGEDENIC ULCERATION.—This condition has already been referred to (see Part I., Chap. XIII.) and is very serious indeed when the gangrene is of the rapid spreading type; it is then associated with considerable loss of tissue and may even end in the death of the patient. It is especially serious when there is either congenital or acquired phimosis.

Treatment.—This has already been dealt with. The patient should be anaesthetised as soon as the diagnosis has been made, and the whole

affected area must be clipped away, the prepuce being slit up to enable this to be done. It is not uncommon to find that the prepuce has sloughed over a large area and that the glans penis projects through it. The raw surface left after removal of the sloughs should be destroyed thoroughly with a cautery at a dull red heat or by fuming nitric acid, which should be neutralised by douching with a solution of carbonate of soda after it has acted for about ten minutes. Boracic fomentations are then applied until the wound is granulating. Skin-grafting may be performed if a large raw surface is left. Internally, tonic treatment and the administration of stimulants will be called for.

GANGRENE OF THE PENIS.—This is of rare occurrence and the gangrene is practically always of the moist variety, resulting either from constriction of the organ by some unyielding substance, such as a ring or a ligature, from very tight paraphimosis or from extravasation of urine following a calculus impacted in the penile urethra. It may also be a complication of specific fevers, such as typhoid or smallpox, and may occur in connection with diabetes, alcoholism or Bright's disease.

Treatment.—When the gangrene is only slight, the penis should be disinfected and boracic fomentations should be applied until the sloughs have separated, after which skin-grafting may be required to cover the raw surface left. When the whole thickness of the organ is affected, the best plan will be to amputate the penis (see p. 434) well above the line of demarcation.

INDURATIONS OF THE CORPORA CAVERNOSA.—Extensive localised indurations of the corpora cavernosa may be met with and lead to difficulty in erection or to lateral deflection of the organ accompanied by much mental distress to the patient. These indurations may be due to injury or to gummatous infiltration, but in some cases no origin can be traced. Microscopic examination shows an increase of fibrous tissue accompanied by endarteritis. Except for the local inconvenience, the condition is not serious.

Treatment.—This is practically of no avail for the cases in which no syphilitic or gouty origin can be traced. Operative interference is useless because the scar produces the same inconvenience as does the thickening, and moreover operative interference does not check the spread of the induration. When there is a gouty history, suitable medicinal treatment is indicated, while for syphilitic cases iodide of potassium is given internally, and mercurial or iodide of potassium ointments are applied locally.

CHAPTER XLIII.

NEW GROWTHS OF THE PENIS.

THE only important growths affecting the penis are papilloma and epithelioma.

PENILE WARTS.

These are common complications of gonorrhœa; they are probably not due to the gonococcus itself but are caused by the irritating discharge. They also occur in connection with frequent attacks of balanitis. Gonorrhœal warts are exceedingly common in the female in whom they may cover the entire vulva; in the male they may also be met with about the cicatrices of soft sores. The growths require to be distinguished from condylomata, especially in the female; this is readily done by noticing their pedunculated character, their characteristic papillæ and the absence of any tendency to undergo ulceration.

TREATMENT.—The most satisfactory method is to snip the growth away. Single warts may be snipped off with a pair of scissors curved upon the flat and the bleeding stopped by a nitrate of silver point. Small isolated gonorrhœal warts occasionally heal satisfactorily if they are kept clean and dusted with equal parts of oxide of zinc, calomel and starch, but removal with scissors is a quicker plan. When the area affected is very extensive and it is desirable to avoid leaving a large raw surface, the warts may occasionally be made to disappear by keeping them dry and painting them daily or every other day with salicylic collodion (100 grains of salicylic acid to the ounce of flexile collodion).

EPITHELIOMA OF THE PENIS.

This is the common form of malignant disease of this organ and it commences more frequently upon the glans than upon the prepuce. It usually commences in the sulcus behind the corona, but it may occur at the preputial ring. Phimosis apparently plays an important part in the

etiology of the affection, probably owing to the continued irritation of retained secretion. As a rule the growth is warty in character and in the early stages is frequently confounded with a simple papilloma, whilst in the later stages it is mistaken for a gumma. Any warty growth upon the penis in an old subject should be looked upon with the gravest suspicion and careful examination will usually reveal an induration of the base from which it grows. In doubtful cases no time should be wasted in keeping the case under observation, but a portion of the edge of the growth should be removed for microscopical examination. The tumour is rapid in its growth and penetrates deeply into the glans; when once it implicates the corpora cavernosa it spreads rapidly through that structure. It may spread into the corpus spongiosum and lead to difficult and painful micturition and ultimately to the formation of fistulæ. The glands in the groin are affected early, very frequently on both sides.

TREATMENT.—The only method of any use is amputation of the penis, and no time should be lost, as this is one of the most fatal forms of epithelioma.

Amputation of the penis.—There are two methods at the disposal of the surgeon, one being amputation of the penile portion anterior to the scrotum, the other being the removal of the entire organ including the crura of the corpora cavernosa.

Amputation of the penile portion.—This operation is suitable for those early cases in which the growth is situated upon the glans and has not infiltrated the corpora cavernosa or infected the glands in the groin to any extent. The patient should lie upon his back with the legs hanging over the end of the table or should be in the lithotomy position; the parts are shaved and purified in the ordinary manner and the penis is encircled by india-rubber tubing or by some suitable clamp applied immediately in front of the scrotum so as to arrest the circulation (see Fig. 101). The organ is then held in the vertical position and a full-sized straight bougie is passed down the urethra as far as the tourniquet. The best form of amputation is that by a long flap fashioned from the skin of the under surface of the penis, which must be long enough to cover the end of the organ comfortably and should be slightly rounded, its length being rather more than half the circumference of the penis at the point of amputation. It should consist of the skin and subcutaneous tissue and can be readily raised by a few touches of the knife. The penis should not be put upon the stretch as the flap is cut.

After the flap has been raised and turned back, its two ends are joined across the dorsum by an incision slightly convex downwards, and then the knife, with its blade horizontal, is thrust between the corpora cavernosa and the corpus spongiosum, its cutting edge is turned upwards and it is made to divide the corpora cavernosa at right angles to the long axis of the penis on a level with the base of the flap. A few touches of the knife will suffice to separate the corpus spongiosum from the divided corpora cavernosa and

the former is divided about half an inch below the base of the flap, cutting cleanly down on to the instrument in the urethra, which is then removed. A pair of catch forceps is applied to the cut end of the urethra, the tourniquet is removed and all bleeding is arrested. Bleeding vessels are generally found in the centre of each corpus cavernosum while the dorsal artery of the penis will require ligature on each side, as will also those in the septum between the corpora cavernosa; these may be difficult to seize and may require fenestrated artery forceps.

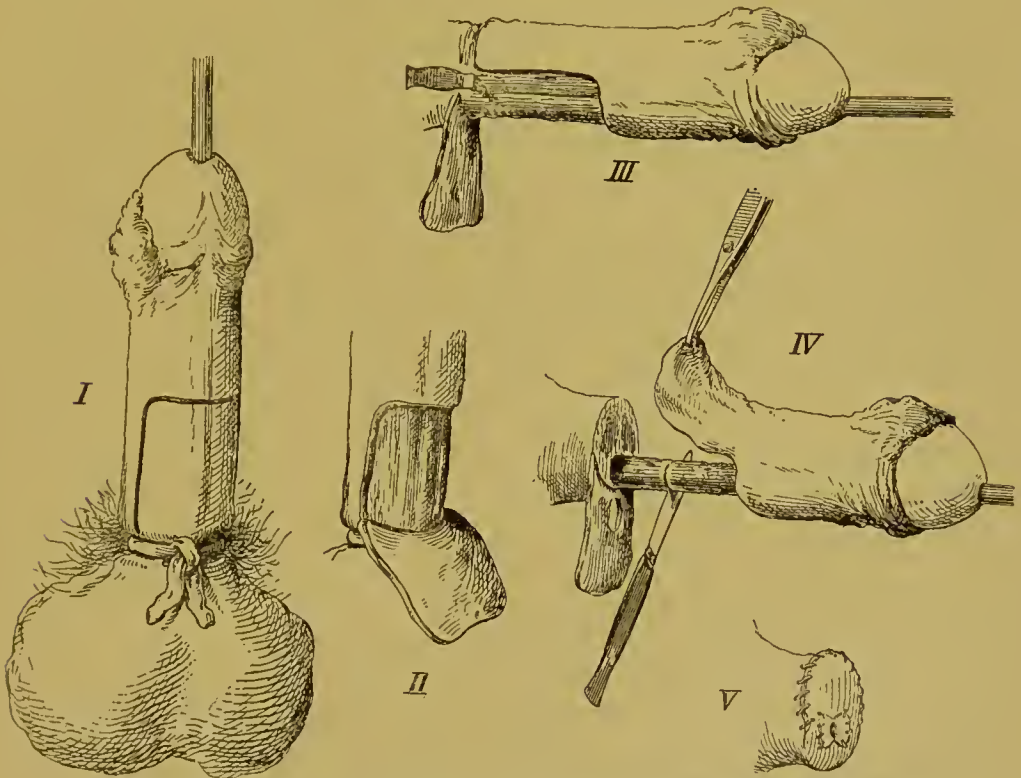


FIG. 101.—AMPUTATION OF THE PENIS. I. shows the tourniquet applied, the catheter in position, and the flap marked out; this flap is reflected in II. In III. the dorsal incision has been made and the knife is transfixing the organ between the corpus spongiosum and the corpora cavernosa preparatory to dividing the latter. This has been done in IV. where a hole has been made in the flap for the urethra which is in the act of being divided. V. shows the stump sutured.

When the bleeding has been arrested, a small vertical slit is made in the centre of the flap and through this the end of the urethra is drawn. The flap is now stitched to the skin on the dorsum, and the orifice of the urethra is then secured to the aperture in the flap. It is necessary to see that this is larger than the normal calibre of the urethra, so as to allow for contraction during healing, and this is best done by slitting up the urethra for a short distance upon its upper and lower surfaces and carefully stitching the edges to the opening in the flap. If there be any oozing from the cut surfaces of the corpora cavernosa a fine catgut drain may be inserted beneath the flap for a day or two. The best dressing is a large boracic fomentation as for circumcision (see p. 425); the patient is allowed to micturate spontaneously.

One or two points must be carefully attended to in order to perform this operation successfully. The first is that the relative positions of the skin and the body of the penis should not be disturbed; that is to say the skin should not be drawn forwards when the flap is being fashioned as otherwise it will be too short. A second point is that all bleeding points must be arrested before the flap is sutured or otherwise union will fail. The third point is that the orifice of the urethra must be made over full size and carefully sutured so as to allow for any subsequent contraction.

A flap from the under surface of the penis is preferable to one from the dorsal surface, as the urine does not pass over the line of union when the patient micturates. The flap operation is far better than the ordinary circular amputation as there is less pain on micturition afterwards, healing is more rapid and there is less contraction about the urethral orifice subsequently. The patient need not be confined to bed for more than two or three days. It is very rarely necessary to pass a bougie, but it must be employed should any sign of contraction be apparent.

Complete extirpation of the penis.—This is much the better operation when the disease is more extensive and definitely encroaches upon the corpora cavernosa. In cases of very extensive disease it is obviously the only possible operation, but in any case its complete character gives the patient a much better chance of avoiding recurrence than can an amputation in front of the scrotum when the growth has invaded the corpora cavernosa. It is performed as follows: The patient is put in the lithotomy position, the parts are shaved and purified as usual, and an incision is made through the middle line of the scrotum splitting it right down to the corpus spongiosum as far back as the bulbous urethra. A full-sized gum-elastic bougie is passed down to the triangular ligament in order to facilitate the recognition and isolation of the urethra in that position. The corpus spongiosum is now divided transversely about an inch and a half in front of the triangular ligament, isolated from the corpora cavernosa and left hanging out of the wound whilst the rest of the operation is proceeded with. The bougie is removed after the urethra has been divided.

The incision splitting the scrotum is now carried up around the root of the penis on each side, uniting over the dorsum of the organ and prolonged up to the symphysis pubis over the suspensory ligament of the penis. The incision is gradually deepened, the two halves of the scrotum are drawn aside and the crura are exposed to view. The incision along the dorsum is deepened up to the front of the symphysis pubis, the suspensory ligament of the penis is exposed and divided and the dorsal vessels are secured. The crus penis is then peeled off from the pubic arch on each side, partly with a periosteum-detacher and partly with the knife. When the crura are detached, the entire penis is removed by a few touches of the knife. We are not inclined to perform castration simultaneously with the amputation, as some surgeons recommend, because of the serious psychical effects that may follow the operation.

After arresting bleeding, a drainage tube is inserted at the anterior angle and the two halves of the scrotum are united by interrupted sutures of catgut or silkworm gut right down to the posterior end of the perineal incision, to the extremity of which the urethra is sutured after being slit on its upper and lower surfaces as in the other method of amputation. Gauze dressings are applied and are kept in position by a T-bandage. The patient micturates normally, the dressings being removed and renewed every time he does so. The functional result of this operation is much better than that of the other method. The patient does not wet himself, whereas in cases of amputation in front of the scrotum the urine is very apt to spray out and set up eczema scroti.

In both these operations the glands in the groin should be removed if enlarged. When however infected glands extend into the iliac fossa, amputation of the penis is contra-indicated except possibly when the local trouble is very severe. In that case the object of the amputation is merely to get rid of the local disease and so to allow the patient to micturate in comfort. In cases in which amputation of the penis is considered inadvisable, either owing to the extent of the disease or to other causes, the patient, if he suffers much on micturition, will be relieved by a median perineal section (see p. 371); it is a good plan in these cases to expose the urethra, divide it across and then to isolate the proximal end and bring it out into the perineal opening. This will not only obviate passing urine over the ulcerated surface of the growth but it will avoid any necessity for the use of a perineal catheter, as there is then no tendency for the perineal wound to close; moreover, urine cannot find its way along the penile urethra to the growth.

CHAPTER XLIV.

AFFECTIONS OF THE SCROTUM.

INJURIES.

WOUNDS OF THE SCROTUM.—These may be incised, punctured or contused. They may be limited to the skin or they may extend deeply enough to expose the testis; the latter may be protruded or even wounded.

Treatment.—This is conducted on ordinary principles. The scrotum is shaved and purified in the ordinary manner, any soiled or bruised tags are cut away and the edges are brought together with fine interrupted cat-gut sutures; drainage should always be provided. Should the testis be protruding, it should be purified and replaced. If some time has elapsed since the protrusion of the testis, an acute hydrocele may have formed and will require tapping before reduction can be effected; the parts should be very thoroughly purified before the tapping is performed. The chief trouble in wounds of the scrotum occurs from extravasation of blood into the dartos giving rise to a hæmatoma of considerable size that may take long time to become absorbed. This is a reason for being extremely careful in the first place to arrest bleeding completely and in the second to provide by drainage for subsequent oozing.

CONTUSIONS OF THE SCROTUM.—When of sufficient importance to call for treatment these injuries generally take the form of the so-called “scrotal hæmatocele” in which there is extravasation of blood into the dartos, the septum scroti or the tissues between the dartos and the tunica vaginalis. In rare cases this hæmatocele may communicate directly with the cavity of the tunica vaginalis in which there is then also a collection of blood. The usual causes of this condition are direct injury, bleeding from vessels unsecured in operations upon the parts, or contusion of the scrotum in breech presentations in newly-born infants; these last are particularly important as the soft parts are liable to slough.

The nature of the affection is evident, and the only point in the diagnosis is the difficulty of being sure that there is no hæmatocele

present in the tunica vaginalis. In scrotal hæmatocele the testicle, if it can be felt, moves independently of the swelling.

Treatment.—The patient should be put to bed with the scrotum supported on a small firm pillow or on the apparatus recommended for acute epididymitis (see Fig. 103). Cold lead and opium lotion should be applied, but no intense cold, such as that produced by an icebag, should be used unless bleeding be actively proceeding, as sloughing in the delicate scrotal tissues is likely to occur under these circumstances. Should it be necessary to use intense cold, a double fold of lint should be interposed between the scrotum and the icebag.

When the effusion has become stationary and the acuter pain has disappeared, the scrotum should be enveloped in a thick layer of wool outside which a firm elastic suspensory bandage is applied. The swelling often takes several weeks to disappear entirely and, if it be very large in the first instance and slow in disappearing, the progress of the case may be hastened by opening it, evacuating the contents and inserting a drainage tube under full aseptic precautions. This will also be required should septic symptoms develop.

INFLAMMATORY AFFECTIONS OF THE SCROTUM.

ECZEMA SCROTI.—This is a common affection and may be merely part of a general eczema or may be set up by some direct irritation such as the dribbling of urine which occurs in children from phimosis or stone or in adults from stricture or enlarged prostate. The condition is very prone to occur in gouty and diabetic subjects in whom it gives rise to much trouble.

Treatment.—Any local condition giving rise to the trouble must be carefully searched for and remedied if present. When the parts are very irritable and weep freely, the patient should be kept in bed for a few days with the scrotum supported (see Fig. 103) and cold lotio plumbi continuously applied to it until the acute symptoms have subsided. The lotion may be iced if necessary, but opium should not be added for fear of dangerous absorption from the raw surface.

After the acute symptoms have subsided, the use of diachylon ointment is indicated, or equal parts of oxide of zinc and starch or two parts of oxide of zinc, one of boracic acid and two of starch may be used as a dusting powder in the milder cases. The insomnia, which is often a troublesome feature in these cases, may be met by the administration of a draught consisting of syrup of chloral (ʒj), liq. morph. hydrochlor (m ʒi), and bromide of potassium (grs. 20). Should this fail, recourse may be had to a suppository containing half a grain of morphine with a quarter of a grain of extract of belladonna. When the affection is part of a general eczema, a stomachic tonic, such as rhubarb or gentian, should be administered in combination with a saline. Gout or diabetes must be looked for and appropriately treated.

ECZEMA INTERTRIGO.—This condition occurs on the scrotum in stout persons and young children as the result of chafing of the opposed surfaces of the scrotum and the thigh. It is simply and effectually treated by using a dusting powder (see p. 439) and interposing a fold of boracic lint between the opposed surfaces; at the same time a suspensory bandage should be worn.

ERYSIPELAS OF THE SCROTUM.—Scrotal eczema if neglected is apt to be complicated by septic infection, and the case then becomes one of erysipelas, cellulitis, or both. The affection occurs also in venereal disease or phimosis, in balanitis or in cases in which there is constant dribbling of urine. Grave and extensive phlegmonous erysipelas of the scrotum may result from extravasation of urine or from injection into the scrotum of irritants destined for the interior of a hydrocele sac. The gravest form of the affection occurs in the subjects of Bright's disease or diabetes.

The scrotum swells enormously, becomes red, tense and shiny, pitting deeply on pressure. There is a special tendency for widespread sloughing to occur. The redness passes into a dusky lividity which rapidly goes on to gangrene.

Treatment.—This is similar to that for the affection elsewhere (see Part I., p. 218). Should it be necessary to make incisions into the tissues owing to sloughing or imminent suppuration, they should be very free indeed and, even should they completely expose the testes, no apprehension need be caused, as, when cicatrisation occurs, it is rapid and complete and the testicles are readily covered in.

ELEPHANTIASIS SCROTI.

This disease is rare in this country and we can say little of it from personal experience. We shall therefore merely indicate the chief points and, should the reader have occasion to deal with a case of this kind, it will be advisable for him to refer to the writings of those who have had special experience. True elephantiasis scroti is characterised by marked and persistent hypertrophy and œdema of the skin and cellular tissue and is due to repeated attacks of congestion associated with obstruction of the scrotal lymphatics. In true elephantiasis this obstruction is due to the *filaria sanguinis hominis*, but in a few rare cases it appears to be due to inflammatory blocking of the lymphatics as in tuberculous disease.

Treatment.—In the slighter cases it is sufficient to support and compress the scrotum firmly in a good lace-up bag-truss. As the thickening advances, the weight of the tumour causes great inconvenience, and the scrotum becomes enormously hypertrophied until it may weigh a hundred-weight or even more. Excision of the hypertrophied mass is definitely called for under these circumstances.

In excising the hypertrophied area it is very important that every part

affected should be removed, while at the same time care must be taken not to damage the penis, and the testicles must not be removed. It is most difficult to avoid injury to the penis which lies buried at the bottom of a deep pit caused by the downward drag of the hypertrophied scrotum. The chief trouble in removing these hypertrophied masses is hæmorrhage. This may be temporarily controlled by an elastic ligature kept in position by long pins thrust through the scrotum on each side of the penis from behind forwards about the level of the commencement of the hypertrophy of the skin. The incisions must be planned so as to remove all the diseased area, but if possible enough skin should be left to cover the testicles. Before commencing the operation it is well to ascertain the position of the penis and to isolate that. When enough skin cannot be left to cover in the testicles Thiersch's grafts may be employed about ten days or a fortnight after the primary operation.

LYMPH-SCROTUM.

In this condition the scrotal lymphatics are markedly varicose and there are frequently small vesicles on the scrotum discharging a fluid consisting of a mixture of lymph and chyle. The condition seldom requires surgical interference unless inflammation occurs in connection with it.

SYPHILIS OF THE SCROTUM.

Scrotal affections are not uncommon in the first two stages of syphilis. *Chancres* may occur in the primary stage, and the scrotum is a comparatively common seat of *condylomata* in the secondary stage; many of the ulcers found on the scrotum in secondary syphilis are really ulcerating condylomata.

Treatment.—This is similar to that of the affection in general (see Part I., Chap. XII.).

SCROTAL TUMOURS.

Tumours of the scrotum may be simple or malignant; the most common are probably sebaceous cysts, which need not be further referred to, and epithelioma, which is not an uncommon affection.

EPITHELIOMA SCROTI.—This disease has received the distinctive name of "chimney-sweep's cancer" but it appears not to be limited to this trade as it occurs also in paraffin workers and in others in whom the scrotum is liable to irritation from the material in which they work.

Chimney-sweep's cancer usually manifests itself as a small, hard, warty scrotal growth covered with a firm scab and increasing very slowly at first. It may be several years before it assumes active growth but, however slow its early stages may be, a period comes at which it assumes the characters of an ordinary epithelioma and it is then followed by rapid enlargement of the inguinal glands and general dissemination.

Treatment.—Early and free excision must be practised here as for malignant disease elsewhere, and any suspicious warty surface on the scrotum should be removed freely even though there may be no history of rapid growth. The incision should be elliptical and go at least an inch wide of the base of the tumour in all directions; the whole thickness of the skin and dartos should be taken away. Castration will be called for should there be any sign of adhesion of the scrotum to the testis, but in ordinary cases this is unnecessary. The inguinal glands, at any rate those on the same side as the tumour, should be carefully examined and, if there be any suspicion of enlargement, the entire glandular area must be extirpated. There is really nothing special in the treatment of this affection except to remember that the case should be treated very early and that the apparently benign character of the growth in the early stages should not be allowed to mislead the surgeon as to its true nature.

CHAPTER XLV.

ABNORMALITIES IN THE DESCENT OF THE TESTIS.

ABNORMALITIES in the descent of the testis are the only developmental defects of the organ that are amenable to treatment. They may be divided into two large groups, one of which is termed retained or imperfectly descended testis, and the other ectopia testis, in which the organ has found its way into some abnormal position.

RETAINED TESTIS.

The testis may be arrested in any part of its course from the abdomen to the bottom of the scrotum, and in some cases it does not enter the inguinal canal at all; the condition may be unilateral or bilateral. Different views are held as to the cause of this, but they need not concern us here as they have no bearing upon treatment. When the testes lie in the inguinal canal the funicular process of peritoneum which descends with them is practically always open and therefore the majority of cases are complicated with a congenital inguinal hernia. Even when a hernia is not actually present at first it is always liable to occur later on.

Testes in an abnormal position are usually imperfectly developed and some hold that they are incapable of discharging their functions when they lie in the inguinal canal; this point however is not quite certain and it would appear that if the testicles be brought down into the scrotum sufficiently early in life they may enlarge and discharge their functions satisfactorily.

This condition possesses a variety of risks. Besides the fact that the organ is possibly functionally useless, a congenital hernia is very likely to accompany it. The testicle is also very prone to attacks of acute inflammation not only from the causes that give rise to a similar condition in the normally placed organ but apparently from the pressure to which the displaced one is constantly subjected and from the greater liability to injury from sudden movements, such as violent flexion of the hip joint and blows or kicks

upon the groin. It has moreover a peculiar tendency to undergo partial or complete torsion, so that the cord becomes twisted and the organ may become entirely deprived of its blood-supply and may undergo gangrene. Any attack of inflammation of the testis in this region is serious, because not only is there great pain and constitutional disturbance owing to the immediate proximity of the abdominal cavity, but the affection is frequently mistaken for a strangulated hernia. When torsion of the testis takes place and gangrene occurs, infection of the peritoneum is almost certain to occur. Hydrocele and hæmatocele are not uncommon complications of this condition and it is said that a retained testis is more liable to become the seat of malignant disease than is a normally placed one.

TREATMENT.—The foregoing facts indicate that it is advisable in all cases to remove the testicle from its abnormal position. Palliative treatment is of little avail. The old plan of applying a truss with a horseshoe-shaped pad so as to occlude the inguinal canal after the testis had been pulled down beyond the external ring and so to prevent it going back has little to recommend it. The hernia practically never becomes cured, neither does the testis descend into its normal position in the scrotum. Indeed we should be inclined to say that the presence of a hernia is rather an advantage than otherwise as far as the descent of the testis is concerned.

The only rational treatment is by operation, and this may have one of three aims: 1. To bring the testis into the scrotum; 2. to replace it in the abdominal cavity; or 3. to remove it altogether. The factors influencing the decision as to which of these methods should be employed are mainly the condition of the testis, its situation, and the length of the structures forming the cord. When the patient is under observation from the first, it is perhaps best to delay the operation until the child is at least four years old, that is to say, until he is intelligent enough to avoid wetting the dressings. There is no urgency about these cases and therefore the operation should not be undertaken whilst the child is still an infant. Should a congenital hernia be present and should the child be able to be under constant medical supervision it is best not to employ a truss, as the hernia can always be cured at the time the operation on the testis is undertaken and the protrusion of the hernia not only helps to stretch the cord but pushes down the testicle in front of it and leads to the development of a cavity in the scrotum into which the testis is afterwards placed; it thus materially helps the success of the subsequent operation. If the child be under observation, any sign of strangulation may be observed at once and the necessary measures taken.

(1) **Re-position of the testis in the scrotum.**—The chief difficulty in this operation is the imperfect development of the scrotum. This is most marked when both testicles are imperfectly descended and then, even though the testes can be brought down to the bottom of the scrotum, the latter is not large enough to contain them and the very elasticity of the dartos tends to squeeze them out again. The second difficulty is

the shortness of the tissues forming the cord, but in this connection it is most important to remember that the vas deferens itself is nearly always long enough, provided that the testis has descended to the neighbourhood of the external abdominal ring. Indeed special care has to be taken in separating the testis from the hernial sac so frequently met with in these cases not to injure the vas, which generally coils over the sac and extends to a lower level than does the testis itself. The tissues that are unduly short are the vessels, and fibrous structures and, if these be divided, the organ can be brought down satisfactorily. The structures of the cord are spread out over the funicular process and the latter has to be most carefully separated from them as low down as the epididymis. This is often a difficult matter as the process is very thin and the structures of the cord are closely adherent to it.

The usual incision for the radical cure of hernia (see Part VI., Section I, p. 450) is made, and the external abdominal ring is exposed in the usual manner. Even when the testis is well within the inguinal canal a mass of tissue generally bulges through the ring, and corresponds to the fat outside the sac and the remains of the gubernaculum testis. The external spermatic fascia is divided and the external oblique aponeurosis is slit up as for a radical cure and the testis with the hernial sac and the structures of the cord are lifted out of the inguinal canal and cleared as far as the internal ring. The structures of the cord are then identified and the vas is isolated, and these structures are carefully and gradually peeled off the sac, which is then cut across below immediately above the epididymis and the upper end is cleared well up to the internal abdominal ring and clamped pending the treatment of the testis. The latter is now pulled downwards towards the scrotum so as to put the tissues of the cord upon the stretch and to ascertain which of them resist its re-position. Any constituents of the cord, except the vas, that offer resistance should be freely divided after being ligatured in two places. Practically all the structures of the cord may be divided, much as in the radical cure of varicocele, without damage to the testis; sufficient blood and nerve supply accompany the vas to prevent necrosis of the testis. When this has been done the parts will be sufficiently elongated to enable the testis to be carried down to the level of the bottom of the scrotum without any undue tension on the cord.¹

When the cord has been sufficiently elongated, the finger is pushed down into the corresponding half of the scrotum and a pouch is made for the reception of the testis. A silk or catgut ligature of medium thickness

¹ It is recommended in most text-books that, if there be difficulty in getting the testis easily down to the bottom of the scrotum, additional length should be obtained by separating the lower portion of the vas from the back of the epididymis as far down as its junction with the globus minor and then turning the testis upside down and so obtaining an inch or so more length. We have never found this manoeuvre necessary in any of the many cases upon which we have operated in children. It may occasionally be necessary when the operation is done in an adult, but even then in our experience only very exceptionally.

is then threaded on a nævus needle and passed through the remains of the sac and tunica albuginea at the bottom of the testis and then unthreaded. One end of the suture is next threaded upon the needle again and passed down through the bottom of the pouch made in the scrotum, being guided down upon the finger. The needle is unthreaded and the stitch is left protruding from the bottom of the scrotum while a similar procedure is gone through with the other end, so that eventually there is a stitch looped through the bottom of the testis with its ends protruding from the bottom of the scrotum side by side and a little distance apart. Traction upon the ends of this thread will pull the testis well down into the bottom of the scrotum and put all the structures upon the stretch. The ends of the ligature are now caught in clamp forceps and are given

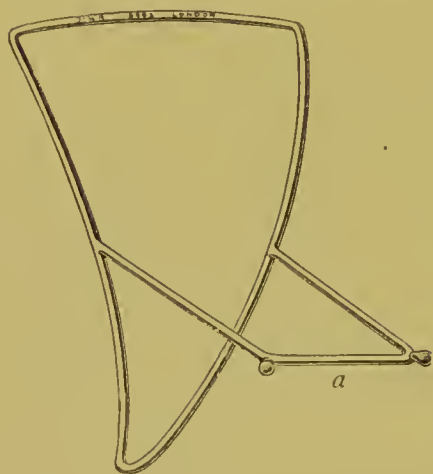


FIG. 102.--WIRE FRAME FOR RETAINED TESTIS. The testis is pulled down and the thread is fastened to the bar *a*. The base of the triangle lies over the symphysis, the apex in the perineum.

to an assistant to hold, whilst the surgeon proceeds to finish the radical cure of hernia, which should be done on the principles already laid down (see Part VI., Sec. I., p. 450). The wound is then closed in the usual manner and a collodion dressing applied, outside which a larger cyanide gauze dressing is put on, the latter being prolonged well down to the bottom of the scrotum.

The final step is the method for keeping the testis down in the scrotum and in this the wire frame shown in Fig. 102, has many advantages over the older plans of stitching the scrotum to the thigh.¹ The cage is made of

moderately soft wire and can be moulded to fit the particular patient. It is fastened on outside the dressing by means of tapes, one of which extends from each side of the base around the body between the crest of the ilium and the great trochanter, whilst two tapes are fastened to the apex and pass up in the folds of the buttock to the tape around the waist; when these are tied the apparatus is fixed in position and the transverse bar is immediately below the bottom of the scrotum. The ends of the silk ligature are now taken and are passed around the bar one on either side, and are tightened up to the desired extent and tied in a bow. This keeps the testis down in place with the scrotum stretched over it, and there is no chance of its receding as long as the stitch holds. A little extra dressing is applied outside, so that the whole apparatus is incorporated in it.

The dressings are changed in about five days, when the skin stitches may be taken out and the traction thread somewhat tightened up so as to pull the testis a little lower down. This may be done at intervals of

¹ See *Med. Society's Transactions*, Vol. XIII., p. 497.

every few days until the ligature either cuts its way through or becomes sufficiently absorbed to break if it be of catgut. If it has not given way before, it may be cut and pulled out at the end of three weeks and the minute aperture covered by collodion.

The result of pulling on the testis in this manner is to stretch the structures of the cord as well as the scrotum and, moreover, the cord becomes fixed in the cicatricial tissue and the testis does not retract. Very good results have followed this method, the testicle increasing in size and obviously developing. Even should full success not be obtained and should the testis retract to the upper part of the scrotum, it is still outside the inguinal canal and in a position in which it is free from injury and may undergo development. This partial recession occurs especially when the descent of both testis is defective and the scrotum is therefore undeveloped; even here the improvement is great and the operation should always be tried in preference to castration.

(2) **Re-position of the testis within the abdomen.**—This may be done when the testis is situated very high up in the inguinal canal at or even above the internal ring and when it is quite impossible to bring it down satisfactorily. This operation is especially indicated when the testes are of fair size and apparently normally developed and when both organs are undescended.

Any hernial sac present is isolated as before, and then the question arises as to whether the testis should be returned within the peritoneal cavity or should be placed in the sub-peritoneal tissues. The latter is the natural position for it because the organ would have to pass through a slit in the peritoneum if it were returned inside the peritoneal cavity and the cord might be constricted and the development of the testicle interfered with. The best plan is to separate the peritoneum from the tissues outside it for some distance backwards towards the iliac fossa and to place the testis in the cavity so formed. The inguinal canal is then entirely sutured and the operation for radical cure completed in the usual manner.

(3) **Castration.**—This operation may be called for 1. In adults when the testis is extremely small and obviously of no value, and when there is also a hernia. Removal of the testis will greatly facilitate the completeness of the radical cure, as the entire canal can be sewn up without having to leave room for the cord. 2. It may be necessary in young subjects who have suffered from repeated attacks of inflammation, as this is almost certain to prevent development of the testis. 3. It is also called for when gangrene threatens or actually exists, as for example after torsion of the cord. 4. It is obviously indicated when the organ is the seat of tuberculous or malignant disease.

The early stages of the operation are similar to those just described, but instead of preserving the testicle, the cord is clamped and divided on the level of the internal ring and the lower part of it and the testis are

removed. The radical cure of the hernia is then completed in the usual manner (see Part VI., Sec. I., p. 450).

Treatment of complications.—We have already discussed the treatment of *hernia* with which most of these cases are complicated. In *inflammation* of the retained organ it is well to wait for the inflammation to subside before proceeding to radical treatment when, if the attacks have been severe or repeated, castration, followed by complete closure of the inguinal canal, will be the operation chosen. If the inflammation be very severe the surgeon may deem it advisable to remove the testis without waiting, and it sometimes happens that a retained testicle is cut down upon under the impression that the case is one of strangulated hernia. If this be done, the best plan is to complete the operation by removing it. When *torsion of the cord* has occurred or *gangrene* has set in, the proper procedure is immediate castration.

ECTOPIA TESTIS.

Here the testis, instead of passing from the inguinal canal into the scrotum, finds its way elsewhere. There are two chief forms of the affection, termed *perineal ectopia*, in which the testis misses the entrance into the scrotum and passes into the perineum, and *crural ectopia*, in which the testis, instead of leaving the abdomen by the inguinal canal, passes through the crural ring and lies either in the crural canal or turns up on the thigh over the lower part of Poupart's ligament after passing through the saphenous opening. *Pubic ectopia* is sometimes met with but is a very rare condition indeed. Here the testis passes upwards and lies in front of the pubic spine about the region of the root of the penis.

In all cases of ectopia testis the corresponding half of the scrotum is ill-developed. The testicles however are usually well-developed and functionally active.

TREATMENT.—As the testis is subject to injury in these abnormal positions, it should always be replaced if possible, and this is generally comparatively easy except in the femoral form which is also the only one likely to be complicated with hernia.

In *perineal ectopia* an incision is made from the external ring along the fold between the scrotum and the thigh, the cord is exposed and the testicle is pulled up from its bed in the perineum. If it be adherent there the remains of the gubernaculum testis may have to be divided. The organ is completely detached, and then a passage is burrowed down from the external ring into the bottom of the scrotum for its reception. In order to prevent it being extruded from this position the wire frame (see Fig. 102) is indispensable and with it an excellent result may be obtained.

In *femoral ectopia* the treatment is more difficult. The testicle may be so well developed that it is impossible to get it back through the crural canal without enlarging the crural ring and the question will arise as to

whether castration should be performed. The decision will be influenced largely by the liability of the testicle to injury in its abnormal position and also by the condition of the one on the opposite side. If this be normal and in the scrotum and if there be a history of pain and attacks of inflammation in the ectopic testicle, castration should be performed and a radical cure done if there be a femoral hernia. If on the other hand the other testicle be imperfect, the surgeon will hesitate to perform castration and will not do so unless there be a history of repeated attacks of inflammation in it.

When the testicle merely lies in the crural canal, the organ can be replaced in position by opening up the inguinal canal and pulling the testis out from the crural canal and replacing it as recommended for an imperfectly descended organ. The crural canal will then be closed in the usual manner (see Part VI., Sec. I., p. 458).

CHAPTER XLVI.

TRAUMATIC AND INFLAMMATORY AFFECTIONS OF THE TESTIS.

INJURIES.

PUNCTURED or incised wounds of the testis call for no special description; their treatment is similar to that of wounds in general.

CONTUSIONS OF THE TESTIS.—When the testicle is bruised, hæmorrhage occurs beneath the tunica albuginea and, if this be extensive and allowed to remain, complete atrophy of the testis may follow. After the accident there is rapid swelling of the organ, accompanied by intense pain, some collapse and a feeling of sickness. The pain is so severe in bad cases as to cause the patient intense agony.

Treatment.—In very slight cases the application of iced lotions or an ice-bag may be sufficient, but if there be any marked extravasation it is essential to allow it to escape in order to avoid atrophy of the testis. This is quite readily done by making an incision through the tunica albuginea and may if preferred be done by a tenotomy knife introduced through the scrotum over the body of the organ. This allows blood-clot or oozing blood to escape, and healing occurs in a very short time if the wound be kept aseptic.

LACERATED WOUNDS.—When the testis is lacerated the best treatment is probably to remove the organ at once as, when the injury has been so severe as to divide the skin and rupture the tunica vaginalis, the testis will in all probability be hopelessly injured. Moreover, sepsis is almost certain to occur and great risk and trouble will be saved by proceeding at once to castration. The contused edges of the wound in the soft parts should be excised at the same time.

TORSION OF THE TESTIS.—A number of cases have now been operated upon in which the testicle has been twisted to such an extent that its blood supply is cut off and gangrene occurs; this is especially likely to occur in an imperfectly descended testis when the organ hangs

into the tunica vaginalis in a horizontal position and where therefore it is easily twisted around its transverse axis. The accident usually follows some blow or violent strain and gives rise to much shock accompanied by vomiting, tenderness, local pain, and rapid swelling in the region affected. The condition may be mistaken for strangulated hernia.

Treatment.—The best plan is to remove the testis. One or two cases have been published in which the torsion has occurred in the case of a testicle in the scrotum and the condition has not been very severe and the twist has been undone. The occurrence of the twist is easily recognised from the position of the epididymis which comes to the front or the outer side instead of lying behind and to the inner side.

INFLAMMATORY AFFECTIONS.

Either the epididymis or the body of the testicle alone may be affected by the inflammation, or both may be affected simultaneously. The inflammation may be acute or chronic, the latter form being especially associated with tubercle or syphilis. We shall describe the etiology and symptoms of acute epididymitis and acute orchitis separately, but, as the treatment is the same for the two affections, we shall consider that together.

ACUTE EPIDIDYMITIS.—This usually originates in connection with some inflammation in the deep urethra and in the vast majority of cases is gonorrhœal in origin. When it is due to this affection the epididymitis generally sets in during the third or fourth week of the disease, and preceding the attack there are signs that the gonorrhœal inflammation has reached the deep urethra (see p. 375). Any other urethral inflammation may set up an acute epididymitis. It is not uncommon in connection with enlarged prostate in patients who lead a catheter-life. It may occur in connection with inflammation behind a stricture, with prostatic or impacted urethral calculi and after operations such as urethrotomy and lithotomy. It is very rarely of non-urethral origin but occasionally it follows an injury. The affection is seldom followed by suppuration when it is gonorrhœal in origin, but suppuration is not at all uncommon when it is due to injury to the prostate.

There is generally tenderness and thickening along the vas deferens before the epididymis shows signs of inflammation, as the infective organisms spread along the vas or in the lymphatics in its wall on their way to the epididymis. This condition is soon followed by acute tenderness and swelling of the epididymis, which surrounds the body of the testis like a horseshoe and is hard and extremely tender to the touch; the body of the testis itself is unaffected. There is often an acute hydrocele and the scrotum may be red and cedematous. The pain is very acute when the patient is standing with the testis unsupported but subsides considerably when he is on his back with the scrotum well elevated. The pain extends

up into the groin along the course of the cord and there are also all the symptoms of acute inflammation.

The ordinary gonorrhœal form of epididymitis generally reaches its height in four or five days and then subsides, and the patient is free from pain in two or three weeks according to the severity of the attack. Inflammatory thickening however may remain in the epididymis as a hard nodule for a very long period indeed, and this induration has an important influence on the generative value of the testis, as the vas is usually left so obstructed that semen is unable to pass and the patient may be actually sterile should both testes be affected. The testis however does not undergo atrophy, nor do any of the symptoms associated with castration (see p. 460) appear. After coitus the epididymis may swell up from the collection of seminal fluid and may cause pain, but otherwise no ill effects seem to follow.

ACUTE ORCHITIS.—Inflammation of the body of the testis is less frequent than inflammation of the epididymis. It is not uncommon as the result of an injury, when blood becomes effused beneath the tunica albuginea and inflammation results. It may also be of a gouty or rheumatic origin and is not infrequent during the course of specific fevers such as mumps, typhoid fever, smallpox, scarlet fever, or influenza. In these circumstances it may be accompanied by suppuration; this however is rare in mumps.

The symptoms of acute orchitis are somewhat similar to those of epididymitis except that on examination the body of the testis is much enlarged and tender whilst the epididymis is hardly distinguishable. There is moreover not the same tendency to acute hydrocele.

The prognosis of acute orchitis is more serious than that of epididymitis, as the acute inflammatory affection of the body of the testis is apt to be followed by atrophy of the organ. This is especially common after mumps, and not only is the generative function of the testis destroyed but its other functions also, so that, if both sides be affected, psychical symptoms, similar to those following double castration (see p. 460), may arise.

Treatment.—(a) **Of acute epididymitis.**—The objects of this are to subdue the inflammation as rapidly as possible and to get rid of the inflammatory exudation. The patient should be confined to bed on his back with the scrotum raised and supported. One of the best methods of doing this is to take a piece of guttapercha, poroplastic, or thick millboard, about eighteen by twelve inches, and to cut out of it a semicircle large enough to embrace the root of the scrotum (see Fig. 103). Holes are bored at each end of the side from which the semicircle is cut and through these are threaded tapes by which the apparatus can be fastened to a band round the waist and so adjusted that the semicircle embraces the root of the scrotum and the testicles rest upon its upper surface, which should be padded with wool. The under surface of the apparatus rests against the thighs, which are slightly raised, and the knees are tied together. The

shoulders should be kept low, and in this way the testicles are elevated and immobilised, and the pain soon diminishes.

The best local application in the first instance is cold either by an ice-bag or by Leiter's tubes (see Part I., p. 9). The tenderness is such that very little pressure can be borne and a very small ice-bag should be suspended from a cradle and a double layer of lint applied between it and the scrotum; watch must be kept to see that the cold is not too intense as otherwise sloughing of the scrotum will occur. If the cold be producing injurious effects there will be slowing of the circulation and the scrotum becomes blue; to avoid this the application should be intermitted for an hour or two at a time. When the inflammation is not very acute, sufficient cold may be obtained by the application of ordinary evaporating lotions (see Part I., p. 8). Cold is only of value for the first two or three days as a rule.

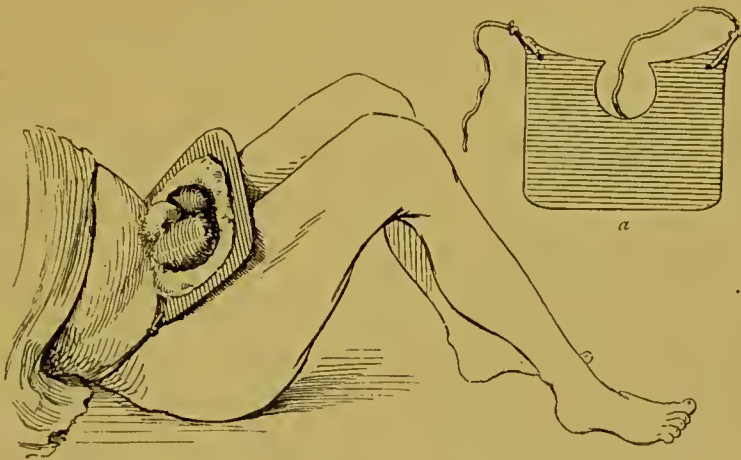


FIG. 103.—SUPPORT FOR THE TESTES IN ACUTE EPIDIDYMITIS. The shape of the support is shown in *a*. The larger figure shows its method of application.

In some cases the pain is so intense that cold fails to relieve it and then more benefit will be obtained from hot fomentations. A piece of mackintosh the same size as the support upon which the testicles lie (*vide supra*) is placed beneath the scrotum, and the fomentation is laid over the front of the testicle; the mackintosh is then folded over so as to cover the fomentation, and a mass of hot cotton wool is applied outside and fastened on by a bandage. Fomentations are especially valuable when suppuration is occurring, but on the whole cold is probably more effectual in arresting the inflammation, as it acts directly on the vessels of the cord; it should therefore always be tried first.

The venous congestion may be relieved by emptying the hæmorrhoidal plexus by a brisk saline purge and keeping the bowels open daily. When the inflammation is very severe, benefit may be obtained by using leeches, but there is always some risk in employing them as it is difficult to arrest the bleeding from the scrotum afterwards; it is better to apply them over the external abdominal ring than to the scrotum. When the inflammation is extremely acute, an even better plan is to purify the scrotum and to open

two or three of the distended scrotal veins with a venesection lancet. Bleeding is then encouraged by applying hot fomentations and there is no difficulty in arresting the oozing.

It will generally be necessary to administer morphine to relieve the pain and to check the restlessness that is associated with the inflammation and the maintenance of the dorsal position. It is best given in half-grain suppositories, to which may be added a quarter of a grain of extract of belladonna. Occasionally benefit may be obtained by the administration of ten-grain doses of salicylate of soda three or four times daily. The diet should consist chiefly of milk puddings and beef tea or soup.

As the inflammation subsides, the scrotum may be enveloped in lint thickly spread with glycerinum belladonnæ, outside which is applied a large

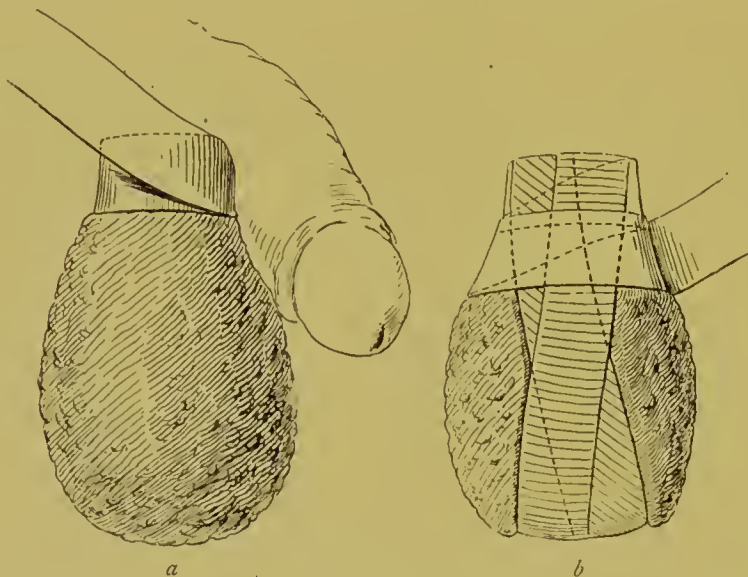


FIG. 104.—STRAPPING THE TESTICLE. The isolation and preliminary fixation of the testicle is shown in *a* where a horizontal turn of strapping outside boracic lint is taken round the root of the scrotum. The method of applying the strips of strapping alternately vertically and horizontally is seen in *b*.

mass of cotton wool kept on by a lace-up bag or a fairly firm bandage. Compression must be employed very carefully at first however because it may do harm if it be begun too early, and special care must be taken to see that the bandage is not drawn tightly enough above the testis to interfere with the circulation.

In a fortnight or three weeks the pain and tenderness will have disappeared, leaving a hard mass in the epididymis, and this is the period at which firm compression is very useful in causing absorption of the inflammatory exudation. The old plan of strapping the testicle is here very valuable. The scrotum is shaved and cleansed, the affected testis is isolated from its fellow, and a narrow strip of boracic lint is wound around the scrotum above it. Over this a strip of strapping is applied circularly and tight enough to prevent the testis from slipping up through it, and then

a series of alternate vertical and horizontal strips are applied as shown in Fig. 104 until the whole organ is covered in. The strapping is applied as firmly as the patient can bear and should be worn for two or three days and then renewed. It should be continued until all the thickening has disappeared from the epididymis. The patient gets about wearing a suspensory bandage or, still better, a pair of triangular bathing drawers that fit quite tightly, with a pad of wool to keep the testicles in contact with the abdominal wall.

When a patient has had one attack of acute epididymitis it is very apt to recur should he again contract gonorrhœa and special care must be taken under these circumstances to keep the testis supported and free from injury.

The only question remaining is that of the treatment of the exciting cause in gonorrhœal epididymitis. It is found that the urethritis diminishes and the discharge may disappear during the height of an acute gonorrhœal epididymitis; as the inflammation in the testicle subsides, the discharge returns. It is inadvisable to irritate the urethra during the acute stage of epididymitis but, as soon as the acuter symptoms are subsiding, the gonorrhœa should be treated vigorously on the lines already laid down (see p. 378). Similarly, when the inflammation occurs in connection with a stricture or an enlarged prostate, steps should be taken to treat the cause as soon as the acute symptoms subside, as otherwise recurrence will occur, with serious results to the testis.

(b) **Of acute orchitis.**—This should be on lines similar to that for acute epididymitis, except that the testis will not need to be strapped, at any rate for so long after the attack. The exudation remaining in the body of the testis is much smaller and is less persistent. In acute orchitis however the surgeon not infrequently has to treat suppuration which is uncommon in epididymitis.

The onset of suppuration may be inferred from the fact that the temperature is high and tends to become irregular, that the pain continues in spite of rest, that the swelling increases and the œdema of the scrotum becomes more marked. Should the suppuration be in the epididymis, a bulging, fluctuating spot will very soon betray the existence of an abscess, but in orchitis it is often a long time before the tunica albuginea softens sufficiently to allow the abscess to come to the surface. As soon as the existence of an abscess is ascertained, it should be evacuated without delay and as a rule healing occurs without trouble and without any hernia testis. Occasionally however it will be necessary to perform castration, especially in cases of septic inflammation of the body of the testis in which there are numerous small scattered abscesses, both because evacuation of one abscess may not relieve the others and also to avoid the risk of general septicæmic infection. Under these circumstances the best plan is to remove the testis by dividing the cord above the scrotum and then to avoid contaminating the wound by removing the whole of the affected area without opening the abscess.

CHAPTER XLVII.

TUBERCULOSIS OF THE TESTICLE.

THIS disease is not uncommon and in the majority of cases the epididymis is affected first and in some cases solely. Except in the early stages however the disease does not remain limited to the epididymis; the vas soon becomes thickened and the vesiculæ seminales are also enlarged in a considerable proportion of cases, at any rate when the disease has lasted for some time. The prostate is not infrequently affected and thence the disease may spread upwards as an ascending genito-urinary tuberculosis.

It is still a matter of dispute as to which portion of the epididymis is first affected; probably the disease commences most often in the globus minor, but apparently in a good many cases the globus major is first attacked. The deposit of tubercle may begin either in the interior of the spermatic duct or in connection with the vessels around it, and it quickly involves the entire epididymis, extending not only up along the vas but into the body of the testis itself, in which the tubercles are first found in the corpus Highmoriani in the intertubular tissue; isolated nodules are subsequently found in the testis.

From the point of view of treatment the affection may be divided up into three groups: 1. Acute tuberculosis of the testicle and epididymis, the so-called "galloping phthisis of the testis"; 2. The ordinary sub-acute or chronic tuberculous epididymitis; and 3. A similar condition that has passed on to suppuration and sinus formation. The question of treatment will also depend on whether the disease is unilateral or bilateral. Although the affection is apparently one-sided in origin, it is very common for the second testis to become affected sooner or later, in some cases within a few weeks or months, in others not for some years.

SYMPTOMS.—*In very acute cases* the disease begins without any apparent cause or it may follow on a gonorrhœal epididymitis, which it closely resembles in its characters. Instead, however, of subsiding as the ordinary gonorrhœal epididymitis does, the pain and swelling persist or increase, abscess occurs very rapidly, often within six weeks, and the vesiculæ

seminales and cord rapidly become affected and from them the rest of the genito-urinary apparatus. Occasionally the body of the testis is alone affected in the first instance, the epididymis being free; in these cases the pain is very acute.

The ordinary sub-acute or chronic tuberculous epididymitis varies much in virulence. There is usually some pain at the commencement of the disease, but it is seldom severe and is generally intermittent and of a dragging character, the chief complaint being of a feeling of weight and fulness in the testis. The gland is very tender on pressure and the vas is generally, although not invariably, thickened. Thickening of the vas, although usually given as a diagnostic sign of tuberculous epididymitis, is not invariably so, and its absence must not be taken as certain evidence of the non-tuberculous nature of the affection.

The enlargement of the epididymis generally reaches its full extent in a few weeks, and it then remains stationary for a considerable period unless an abscess forms. The swelling is a characteristic horseshoe-shaped enlargement surrounding the testis and is largest at the globus major. It is common for an abscess to form in these cases and its occurrence is marked by an increase in the subjective symptoms, especially the pain; eventually sinuses form leading down to the epididymis.

TREATMENT. (a) **Of acute tuberculosis.**—The only treatment that offers any prospect of success is immediate castration. Unless this be done quite early, the disease is almost certain to spread to the rest of the genito-urinary system and it is most important in performing the operation to isolate the cord and especially the vas deferens as far as possible (see p. 464).

(b) **Of sub-acute and chronic tuberculosis.**—This, like the treatment of most other tuberculous lesions, may be considered under the headings of non-operative and operative measures. A considerable number of cases of tuberculous epididymitis become quiescent either without suppuration or after suppuration has occurred, and after a time the thickening may disappear almost entirely. It is however extremely difficult to say in any given case that this is likely to happen. In the acute, rapidly breaking-down forms, especially those affecting also the body of the testis itself, it is fairly certain that the disease will not become quiescent, but in the more chronic cases, in which a firm and painless swelling has been found accidentally in the first instance, it is never possible to be quite certain; some cases improve steadily under general treatment, whilst others, which at first looked equally promising, break down and suppurate.

Non-operative.—If the case be very chronic when first seen, this may be employed when there is tuberculosis elsewhere in the genito-urinary system and when the local lesion has apparently a tendency to recovery. It consists essentially in putting the patient under the best hygienic conditions, supporting the testis well and guarding it from injury. *The general treatment*

is that for tuberculosis in general (see Part I., p. 245). In the *local treatment* belladonna ointment may be employed if there be much pain, while, if there be none, the testis should be supported by a suspensory bandage and it may be lightly strapped with simple strapping (see p. 454) or with mercurial ointment; it is however doubtful whether the latter exerts any really beneficial effect. The injection of iodoform and glycerine or of chloride of zinc into the epididymis does not appear to be of any special value.

Operative.—Formerly this usually took the form of castration, but in more recent years less severe operations have been employed with success. This is particularly the case with the operation called epididymectomy, which aims at removing the disease by excision of the epididymis and cord, leaving the body of the organ intact. More partial operations than this, such as scraping, are also employed but they are not to be recommended.

Epididymectomy.—The operator grasps the testis, turns it inwards so that the epididymis faces him, and makes an incision over it extending from the external abdominal ring¹ down to the lower limit of the testis. If the skin be adherent to an abscess or if there be a sinus, the incision must enclose the affected area. The tissues are divided until the cord, testicle and epididymis are fully exposed and the next step is to separate the two latter structures from one another. The separation is commenced at the body and globus minor, which is attached to the testis merely by fibrous tissue. Care must be taken in raising the epididymis to preserve the blood-supply to the testis which enters it chiefly on the inner side of the globus major, *i.e.* on the side away from the operator—and the vessels should be carefully pushed aside with the handle of the knife or a blunt dissector. The body of the epididymis is raised until the globus major is reached and here there is close organic connection between the epididymis and the body of the testis. The vessels are now carefully separated by a blunt dissector from the deeper surface of the globus major, and an examination must be made to see whether the body of the testis is healthy; if it is, the attachment of the globus major to it is divided. If there be disease, wedge-shaped slices of the testicular structure should be removed until the portion left behind is entirely healthy. The epididymis and the vas deferens are now freed from the other structures of the cord and isolated up as far as the internal ring or higher if the cord be thickened there, and divided as high up as possible.

Bleeding points are tied and the incision in the testis is closed by a few fine catgut sutures through the tunica albuginea; the tunica vaginalis need not be closed. A drainage tube should be inserted at the lower part of the wound for the first 48 hours if there be much oozing. The majority of these cases heal without trouble; occasionally in advanced cases a fistula is left and this may have to be scraped and treated on ordinary lines. In some cases the sexual functions improve.

¹ Or higher up if the cord be definitely thickened.

The chief objection urged against this operation is that it is often only partial, because the affection may be present in the body of the testis itself; this no doubt is true in a good many cases unless the operation be performed at quite an early stage of the disease. There is however no reason why the operation should not be successful even then, provided that the tubercles left behind are fairly isolated and not in large masses. Moreover the operation cuts off the communication between the testis and the rest of the genito-urinary system, and any recurrence that takes place in the testis can be treated locally by scraping out sinuses, etc. It is also urged that the testis may be found seriously diseased and that castration may be necessary after all. This may certainly be the case, but the surgeon is then sure at any rate that he has not needlessly sacrificed an important organ.

Among the most serious objections is the possibility of interference with the blood-supply to the testis followed by necrosis. This has certainly happened and great care must be taken firstly not to attempt the operation when the disease is so extensive that it is necessary to interfere with the blood-supply, and secondly, when the case is suitable for epididymectomy, to preserve the vascular supply intact. Bardenheuer is of opinion that recurrence on the opposite side is more frequent after epididymectomy than after castration and he also states that the secondary disease may be more acute than the primary form. This however does not seem to be the general experience, and, even if it were, and necessitated castration on the opposite side, the patient would still be left with one testicle, whereas in double castration both are removed. It is evident that the operation is well worthy of consideration, but it must be employed with judgment and is not applicable to every case. It is distinctly contra-indicated when the entire body of the testis is diseased, when there is a deposit in the centre of the testicle, when there are advanced lesions of the vesiculæ and prostate, especially with suppuration, when the urinary system is invaded, and when the patient suffers from advanced phthisis. In the last two cases castration or scraping should be employed if operation is advisable at all.

Castration.—This operation is similar to that for malignant disease (see p. 464). The cord should be divided as high up as possible and indeed it is well in all cases to slit up the external oblique aponeurosis and thus to isolate the vas well up in the abdominal cavity before dividing it.

Scraping.—A partial operation of this kind should be limited to cases where the disease has reached a very advanced stage, where it has become generalised and where no other operation is thought advisable. It cannot by any means remove all the disease, but it may do much good by removing the breaking-down deposit that is giving rise to the abscess or the sinus.

Selection of cases.—Up till fairly recently the only question in treatment was between non-operative measures and castration, and the view generally held was that castration might be performed quite early, and must be

performed in any case in the acute form of the disease, but that it should not be lightly undertaken and should only be done as a last resort save in exceptional cases. At the present time however many of the objections to castration are removed by the introduction of epididymectomy and the patient will probably allow this operation to be performed at a much earlier stage than he would castration, and the surgeon will probably be inclined to advise it early rather than persist with non-operative measures, seeing that success depends upon the earliness of the stage at which it is done. Castration is certainly the most effectual operation, especially when combined with section of the vas as high up as possible and, were it not for certain objections, would be advocated in preference to any other. The objections are chiefly that it is impossible to be sure that the removal of the affected organ will arrest the disease, for, even at quite an early period, the trouble spreads along the cord and affects at any rate the vesicula seminalis on the same side, and sooner or later the opposite epididymis becomes attacked in most cases. The proportion of cases in which both sides are affected is certainly large and the affection on the opposite side may occur either soon after the first or after a long interval. If therefore a patient cannot be offered a reasonable hope that the other side will not become affected it may be by no means easy to persuade him to have castration performed at a sufficiently early period in the disease to give a fair prospect of complete recovery.

In some cases however, in spite of the objections urged above, castration is very advisable. It is for example the only possible way of checking the disease in acute tuberculosis of the organ and must then be done at the earliest possible period. It must also be done when there is great pain, especially when the body of the testis is largely affected. It is also called for in advanced cases where there is profuse suppuration which is telling upon the patient's health, and it may be required here even though there be disease in the vesiculæ seminales and prostate.

The objections mentioned above are those which apply to uni-lateral castration. Bilateral castration is a very serious matter indeed, at any rate in many cases. In young patients little or no effect may be produced by the removal of both testes, but patients who are getting on in years frequently lose interest in their affairs, become less acute business men and are lazy, irritable, morose and in some cases actually demented or maniacal as a result of double castration. A considerable proportion of these patients have ultimately committed suicide. The mental disturbance is attributed by some entirely to the psychical effect of the loss of the testis and the fear of subsequent sterility, and surgeons have tried to deceive patients by introducing artificial substitutes, such as balls of celluloid or silk. Quite apart from the fact that healing does not always occur over these materials and that they have to be removed, these attempts have not met with much success and practically have been given up.

It is now generally admitted that the testes, in addition to their generative function, play a very important part in the well-being of the patient, probably by means of their internal secretion, and it is to the loss of this that the mental effects of double castration are mainly due. There is ample evidence to show that, when the vasa are blocked by inflammation or divided by operation and the generative functions are thus abolished, the testes do not waste nor are the mental effects described above noticed.

Experiments performed on dogs seem to show that after the removal of both testes the patient is more likely to succumb to the tubercle bacillus. Dogs previously injected with testicular fluid resist inoculation with tubercle bacilli whilst others not so prepared succumb.

Epididymectomy meets to some extent the objections to the operation of castration. The testis is left and its internal secretion is therefore not interfered with and so there is no objection to operation at the earliest possible period and a similar operation will more readily be assented to should the disease re-appear on the opposite side. Moreover there is no need to urge palliative measures in opposition to operative means, such as epididymectomy, because the generative function of the affected testis is destroyed quite early in the disease by the blocking of the vas and therefore the removal of the epididymis and vas in no way affects the patient's generative power, while the early performance of the operation gives him a much greater chance of recovery.

CHAPTER XLVIII.

SYPHILITIC AFFECTIONS OF THE TESTIS: TUMOURS OF THE TESTIS: HERNIA TESTIS.

SYPHILIS OF THE TESTIS.

THE testis may be attacked either in the congenital or the acquired form of the disease; in the latter case the affection usually occurs either in the transition period between the secondary and the tertiary stages or late in the latter period. In the congenital form and in the early tertiary stages the disease generally takes the form of an infiltration of the testis leading to a comparatively painless general enlargement of the body with loss of testicular sensation and, unless it be treated early and efficiently, loss of function results. The condition is usually associated with hydrocele, and when there is a hydrocele in conjunction with enlargement of the body of the testis it is strong presumptive evidence that the affection is syphilitic.

Gummata are met with in the later stages of syphilis either deep in the substance of the organ or upon the tunica albuginea or both, and these give rise to a hard nodular testis which may also be accompanied by hydrocele although not so frequently as the other form. Gummata may also occur in the epididymis although much more rarely than in the body of the testis; indeed gummata may even be met with in the epididymis alone, when they usually occur in the globus major. Gummata have also been met with on the vas above the epididymis; these conditions however are rare.

A gumma of the testis if left untreated softens and breaks down, becoming adherent to the skin, which is thinned and gives way, so that a large gummatous ulcer with a sloughy base is formed. As the gumma in most cases finds its way through the tunica albuginea this ulceration is frequently followed by a hernia testis (see p. 466).

TREATMENT.—The treatment of syphilitic testicle follows that for syphilis in general (see Part I., Chap. XII.). Mercury and iodide of

potassium should be given in the cases occurring in the early stage and, as it is important to get the patient under the influence of mercury rapidly, it is best given either by inunction or by intra-muscular injection (see Part I., p. 233). When the affection is congenital, mercury should be administered (see Part I., p. 236). Little local treatment is called for; the testis should be supported and the enlargement in the early stages may perhaps be usefully treated by keeping the scrotum smeared with unguentum hydrarg. or 5% oleate of mercury. When the gummata are large and extensive they often do not clear up entirely even under prolonged anti-syphilitic treatment.

NEW GROWTHS OF THE TESTIS.

Tumours of the testis are comparatively rare and are more often malignant than benign. The malignant growths are either carcinomata which originate in connection with the tubuli seminiferi, or sarcomata of the round-celled or, more rarely, of the spindle-celled variety. Sarcoma of the testicle is apt to undergo cystic degeneration and the term "cysto-sarcoma" has been applied to some of these tumours.

Malignant tumours of the testicle are very virulent. The sarcomata occur principally in young children, whilst the carcinomata occur between thirty and fifty years of age. As a rule the tumours, with the exception of the spindle-celled sarcoma, grow rapidly. At first they distend the tunica albuginea and the form of the testis is retained, but this is soon destroyed, and irregular bosses of unequal consistence and often fluctuating in parts are formed. The disease spreads up along the cord, which becomes thickened, usually at a later stage than in inflammatory affections, and the lumbar glands are early affected both by carcinoma and sarcoma. The chances of cure by operation are comparatively slight.

In the early stages the diagnosis, especially from a syphilitic testicle, may be difficult, but the rapid growth of the tumour, its irregular outline and general characters and the absence of marked hydrocele soon settle the question. The tunica vaginalis becomes adherent to the testis and the tissues outside it are then invaded. Death usually occurs within a year of the time that the tumour is first noticed.

Simple tumours of the testis are comparatively rare. The testis is one of the spots in which deposits of cartilage occur independently of bone and in some cases it is possible that these enchondromata are simple tumours. The great majority of them however appear to be sarcomatous in nature and, although perhaps not so malignant as other forms of sarcoma, nevertheless have a malignant tendency. They grow somewhat slowly and are hard and nodular.

Cystic degeneration of the testis is sometimes met with, and the condition differs widely from the more common cystic affection of the testis known as cysto-sarcoma. It is usually not easily diagnosed before incision and,

although not malignant, destroys the testis as completely as any other form of growth; in it the testis consists of a quantity of small cysts.

TREATMENT.—There is only one treatment for all these groups of tumours of the testis and that takes the form of castration. As a rule, the earlier the operation is performed the better will be the patient's chance, but unfortunately the diagnosis is often extremely difficult in the early stages when alone there is reasonable prospect of cure by radical measures. Malignant tumours of the testis occur at periods of life when syphilitic affections are most likely to occur, and when the enlargement is still slight it is very difficult to exclude syphilis with certainty.

Under these circumstances it is legitimate to try the effect of large doses of iodide of potassium combined with mercury and mercurial inunctions for a week or ten days, but, if the enlargement should increase in spite of this, further time should not be lost. The only way of setting the matter at rest is to cut into the testicle, when the soft, malignant tumour substance contrasts sharply with the dense, fibrous syphilitic induration or the caseating gummata. We would here repeat the warning concerning the danger of infection of the surrounding parts when cutting into malignant tumours; therefore the exploratory incision should never be made until the surgeon is prepared to complete the operation by castration if necessary. In any case, if the tumour turn out to be malignant, the incision in it should be stitched up tightly so as to prevent the escape of any of the juices, and fresh instruments and fresh disinfection must be employed and care must also be taken to completely excise the area in which the incision has been made.

Castration.—Castration may be performed either from below upwards, when it commences with enucleation of the testis, or from above downwards when the cord is freed first. In most cases it is best to commence from above downwards and in the case of malignant tumours, especially when there is an ulcer of the scrotum or when an exploratory incision has been made into it, the whole of the scrotum can be covered up completely with antiseptic cloths for the time being while the cord is dealt with first. The same may be said of castration for tuberculous disease with or without ulceration; by dealing with the cord first, infection of the upper part of the wound by sepsis, malignant disease or tuberculosis is avoided.

Before commencing the operation, the penis should be fastened out of the way by a stitch passing from the prepuce to the skin of the opposite thigh, just as for the radical cure of hernia (see Part VI., Sec. I., p. 450). An incision about an inch and a half to two inches long is made so as to expose the external ring on the affected side, the cord is identified as it emerges from the ring, and the inter-columnar fascia and the aponeurosis of the external oblique are slit up as far as the internal ring. The cord is now followed up to the latter situation and, if the vas be normal, an aneurysm needle threaded with catgut is made to transfix the cord, which is tied in two halves, one end of the ligature being finally passed around

the whole to prevent any chance of it slipping. The ligature should be tied as tightly as possible, so as to completely strangulate the nerves and avoid pain afterwards, and it is well before dividing the cord to clamp the lower end with a pair of forceps so as to prevent the escape of anything from the divided vas. Should the operation be done for tuberculous disease and should the vas be found thickened at the proposed point of division, this structure should be separated from the other constituents of the cord and traced back as far into the abdomen as possible, the peritoneum being pushed aside in doing so, until an apparently healthy spot is reached, when it should be ligatured and divided. In this way the vas may be traced down a considerable way towards the bladder. The divided cord is now pulled well down out of the inguinal canal and the latter is immediately repaired, by suturing the external oblique and the external ring as thoroughly as possible. Unless there has been a hernia present it will not be necessary to suture the deeper muscles or the conjoined tendon.

The tumour can now be removed from the scrotum and, as there is no advantage in leaving a large mass of scrotal tissue on that side, it is always well to take away an elliptical portion of the skin so as to reduce the size of the wound afterwards. This is of course imperative if the tumour be adherent to the skin, but in any case it is well to remove enough to prevent any large cavity being left. Therefore two semi-elliptical incisions should be carried downwards from the lower end of the upper incision to the bottom of the scrotum and made to enclose a sufficient amount of skin. In the case of tumour of the testis, the tunica vaginalis should always be removed as well as the testicle and, after the skin and dartos have been divided, traction on the organ by means of the cord will usually enable the entire mass to be removed after a few touches with the knife.

The wound must be gone over most carefully after removal of the testis, and every bleeding point clamped and tied. Oozing into the scrotum gives rise to much trouble on account of the laxity of the tissues and the long time it takes for the clot to become absorbed, and moreover the wound is near to sources of infection. When all bleeding has been stopped, the wound is sewn up, taking special care to see that the edges do not become inverted, as the edges of a wound in the scrotum often tend to do. The wound should be put on the stretch with a blunt hook at each end of the incision and either a running or a button-hole suture will close the cavity. It is not necessary to use a drainage tube unless the case was septic originally or unless it is impossible to stop the oozing. Dressings very similar to those for radical cure of hernia (see Part VI., Sec. I., p. 452) are applied.

Castration should be employed in most cases of malignant disease of the testicle unless definite secondary tumours are present, as, even though the operation may be obviously unable to arrest the disease, the patient

is saved by it from a source of great trouble and discomfort owing to the ulceration and sloughing that must inevitably occur in the primary growth.

HERNIA TESTIS.

By a hernia testis is meant a protrusion of the tubular structure of the organ through an aperture in the scrotum after giving way of the tunica albuginea, or more rarely a protrusion of the entire testis through an opening in the scrotum. This condition should not be confounded with the so-called fungus hæmatodes, which is not a true hernia testis at all but a fungating malignant testicular growth. The term hernia testis ought strictly to be limited to cases in which the tunica albuginea has given way and allowed the tubular structure of the body of the testis to protrude, and should not be applied to the cases in which the scrotum has sloughed sufficiently to allow the entire testis to be herniated.

A hernia of the testis may be caused on the one hand from the bursting of an abscess in the testis through the scrotal walls, as when a gumma softens and perforates the tunica albuginea and the dartos, or by the gradual deepening of an ulcer of the scrotum, generally gummatous, until first the testicle becomes adherent to its base and finally the tunica albuginea is destroyed and a hernia testis results.

The most common cause of hernia testis is gummatous orchitis (see p. 462). Another fairly frequent cause is the extension of a syphilide of the scrotum to the testis. It may possibly occur in extensive tuberculous disease which affects the body of the organ very largely and in which an abscess forms in that situation and finds its way through the skin of the scrotum.

The herniated mass consists of seminal tubules with a large quantity of granulation tissue. It forms a vascular mass, varying in size from a large pea to a plover's egg, which stands out from the scrotum and shows some constriction at its base where the aperture in the skin embraces it. It is covered with granulations and discharges a thin sanious fluid; occasionally it is in a sloughing condition.

TREATMENT.—*In syphilitic cases* great improvement will follow dusting the surface thickly with one part of calomel to three of starch, or equal parts of calomel, oxide of zinc and starch, together with the internal administration of large doses of iodide of potassium, combined with mercury, as for tertiary syphilis (see Part I., p. 235). This treatment will sometimes bring about cicatrization of the hernia and nothing further is needed. In other cases the mass is much reduced and, when the septic condition is got rid of, it may be returned into the scrotum. If this is to be done the best plan is to sponge the surface of the hernia with undiluted carbolic acid two or three days before the operation and to purify the skin around with 1-20 carbolic solution and then to apply compresses of 1-2000 corrosive sublimate for 24 hours over the hernia as a preliminary measure.

An elliptical incision is then made to embrace the cicatricial opening, which is dissected out right down to the herniated mass, after which the testicle is freed from the dartos and it and the hernia are reduced and the incision in the scrotum is sewn up. A small drainage tube should be put into the lower part of the wound for 48 hours in case it has not been possible to render the mass aseptic. Anti-syphilitic remedies should be persevered with. The hernia only requires to be shaved off when it is so large that it cannot be reduced in this manner.

CHAPTER XLIX.

HYDROCELE: HÆMATOCELE: VARICOCELE.

HYDROCELE.

ACUTE HYDROCELE.—This is rare compared with the chronic form, and it generally follows injury or is secondary to acute epididymitis or orchitis; sometimes it is secondary to an inflammatory condition of the scrotum or cord and it may accompany thrombosis of a varicocele or occur in specific fevers.

The surface of the tunica vaginalis becomes coated with lymph, and some obliteration of the vaginal sac may result from adhesion of the opposed surfaces. The effused fluid coagulates readily and as a rule is absorbed quickly when the affection to which it is secondary ceases; the fluid however may occasionally remain as a chronic hydrocele.

Symptoms.—In *acute non-suppurative hydrocele* the outlines of the testicle and epididymis are lost and there is a smooth, fluctuating, translucent swelling which is very tender, the skin over it being red and cedematous; there is no pyrexia.

Treatment.—As this condition is a secondary one, the treatment of the hydrocele itself is not of much importance. Operative interference is very seldom required, but, if the pain be great and the swelling does not soon subside, it is permissible to puncture the sac and draw off some of the fluid. There is however danger of introducing septic material, and moreover coagulation occurs if blood corpuscles get into the fluid, and the sac may become filled with clot which will not only delay recovery but will give rise to partial or entire obliteration of the cavity of the tunica vaginalis. If therefore puncture be employed for the relief of pain, a small exploring needle should be employed and any visible vessels should be avoided. The patient should not be allowed to walk about until the fluid has been completely absorbed, lest a chronic hydrocele result.

Suppuration may sometimes occur in acute hydrocele and is recognised by an increase in the pain and the local symptoms accompanied by pyrexia.

The tunica vaginalis must be laid open freely as soon as the true nature of the condition is recognised. The skin is shaved and purified in the ordinary manner, a vertical incision is made over the outer and front part of the swelling or over any situation in which the abscess is pointing, and the pus is let out; the finger is introduced into the cavity to break down any septa present, a drainage tube is inserted at the most dependent spot and antiseptic dressings are applied in the usual manner, whilst the scrotum should be well supported as for acute epididymitis (see Fig. 103). Healing is generally complete in about a fortnight.

CHRONIC HYDROCELE.—This affection has received different names according to the situation of the encysted fluid. Thus, there is the common variety termed *hydrocele of the tunica vaginalis*; *congenital hydrocele*, in which the funicular process is patent from the abdominal cavity to the bottom of the scrotum; *infantile hydrocele*, where the process is closed only at the internal abdominal ring; *hydrocele of the cord*, in which the funicular process is obliterated at the internal ring above and in the neighbourhood of the epididymis below. There may also be a *spermatocele* or *encysted hydrocele of the epididymis*; *encysted hydrocele of the testis* itself, which is generally a collection of fluid beneath the visceral layer of the tunica vaginalis, and a *chylous or fatty hydrocele*, in which there is a communication with the lymphatic vessels, may also be met with; occasionally the so-called *diffuse hydrocele of the cord* is met with and in this fluid is evenly distributed through the structures of the cord.

(a) **Chronic hydrocele of the tunica vaginalis.**—The tunica vaginalis is distended with a clear, highly albuminous fluid, coagulating readily on the addition of red blood corpuscles. The condition is probably associated with some inflammatory affection of the epididymis. It is also not uncommon as a complication of gummatous disease of the testis and is met with in connection with long-standing herniæ, varicoceles, etc.

The tunica vaginalis may remain normal in appearance and in thickness for a considerable time, but, as time elapses, especially when attacks of acute inflammation supervene upon the chronic, there is an increased thickening of the wall which becomes rigid and after a time the hydrocele may develop into a hæmatocele. Adhesions may also form between the opposed surfaces of the tunica vaginalis and divide the hydrocele cavity more or less completely into loculi.

The diagnosis of hydrocele is simple, but it must be remembered that the affection is not infrequently complicated with a hernia and it is not uncommon to find that there is disease of the body of the testis or of the epididymis when the hydrocele fluid is drawn off.

Treatment.—It is advisable in all cases to get rid of the hydrocele, as, although it does not trouble the patient materially when small, it tends to get steadily larger if left alone, until it becomes a source of great discomfort from its size and weight.

When it can be clearly ascertained that the affection is due to gummatous disease of the testis, the cure of that affection will generally lead to the disappearance of the hydrocele and, in the first instance at any rate, the testicular condition alone should receive treatment. This also holds good when the disease is found to be gummatous after tapping a hydrocele, and in these cases no further treatment directed towards the hydrocele will be required, at any rate until it is seen whether the affection will subside under anti-syphilitic treatment.

Many methods have been introduced for the treatment of hydrocele, of which we may mention the following: Simple puncture, puncture followed by the injection of irritants left in the sac, irrigation of the cavity with irritants such as 1-2000 sublimate solution which are allowed to escape again, incision and drainage, stuffing the cavity, and excision of the tunica vaginalis. Of these, the only two that require any detailed description are tapping followed by injection, and excision of the hydrocele sac.

Simple tapping (see p. 471) does not lead to a cure. It may be advisable when the patient objects to more radical treatment, particularly when he is unable to afford the week or ten days during which he would otherwise have to lie up. The only advantage of simple tapping is that the patient is relieved of his discomfort for a time and can resume work. The objections to repeated tapping, quite apart from the question of inefficiency as a curative method, are the risks of sepsis, which however should not be great, and the risk of bleeding into the sac leading to the formation of a hæmatocele. The points to be borne in mind in simple tapping are that the disinfection of the instruments and the skin should be perfect and that any visible vessel should be avoided.

Drainage was at one time much employed, but it necessitates the patient lying up for from ten to fourteen days and possesses no advantage at all over the really radical method of excision. The same remark applies to opening and stuffing the hydrocele, which is a very objectionable method because of the danger of sepsis and the prolongation of the cure. It is not even justified by the desire to obtain a radical cure, as this is more certainly obtained by excising the sac.

Tapping followed by injection no doubt often leads to a cure and is in some ways a less severe procedure than excision. There is no necessity for a general anæsthetic and possibly the patient is able to get about sooner. At the same time it is inferior to excision in that it is uncertain in its results and possesses a certain amount of risk, especially in old subjects who are in bad health, as the injection may set up more inflammation than is quite desirable; indeed it has even led to sloughing of the scrotum. We are strongly of opinion that excision is the ideal treatment for any patient who desires a radical cure and can give up about a fortnight and especially if he be at all well on in years or feeble in health. It is a simple operation which, if carried out aseptically, has no risk and absolutely prevents recurrence. Moreover it will succeed where

injection would certainly fail, for example when the sac is multilocular or contains loose bodies.

The fluid formerly used for injecting hydroceles was the Edinburgh tincture of iodine, which is stronger than that of the British Pharmacopœia, and a drachm or more of this was introduced into the sac and left there. This operation is accompanied by considerable pain at the time and brisk inflammation afterwards and for this the patient has to lie up. Recently iodine has been largely abandoned in favour of undiluted carbolic acid, which is the fluid that we should recommend when this operation is decided upon. It is probably more efficient than iodine and its use is not accompanied by the pain that follows injection of the latter fluid.

The method is as follows: The skin at the proposed seat of puncture is shaved and disinfected, the patient sits well forward upon the edge of the chair with the legs apart so as to prevent him shrinking back when the puncture is made, and a medium-sized trochar and cannula is thrust into the hydrocele. The point chosen for the puncture should be at the anterior part of the swelling rather above the middle and at a spot free from visible veins, and meanwhile the skin should be made tense over the tumour which is grasped behind its median transverse plane between the thumb and forefinger of the left hand; as the thumb and finger are approximated, the tumour slips forward and the skin is pulled backwards and made quite tense. It is always advisable to make out the position of the testicle beforehand both by palpation and by the translucency test, as in some rare cases the ordinary position of the testis, namely below and behind, is altered and the organ is situated in front. The cannula is held as shown in Fig. 105, the forefinger of the left hand being placed three-quarters of an inch from the point of the trochar so as to prevent it from going too deep, and is introduced by a sharp stabbing thrust. Directly it has reached the interior of the cavity—as will be ascertained by the cessation of resistance—the point is tilted upwards, the trochar is withdrawn and the open end of the cannula is somewhat depressed and pushed a little further onwards so as to avoid any risk of its slipping out of the tunica vaginalis. The fluid is drained off as completely as possible, the tunica vaginalis being compressed by the left hand.

When all the fluid has escaped, carbolic acid is introduced through the cannula preferably by a syringe which fits the nozzle of the former. Should the surgeon not happen to have a syringe of this kind at hand, the best plan is to take a hypodermic syringe with a long exploring needle and to pass the latter down the cannula well into the tunica vaginalis and to inject the fluid in this way. The fluid for injection is made by liquefying pure carbolic acid by heat and adding a few drops of glycerine to prevent it from crystallising in the needle. For a small hydrocele 20 min. will be sufficient, while for a large one the

amount may be increased up to 40 or 50 min. In no case should this quantity be exceeded.

After the acid has been introduced, the skin is pinched up around the cannula and the latter is rapidly withdrawn after the finger has been

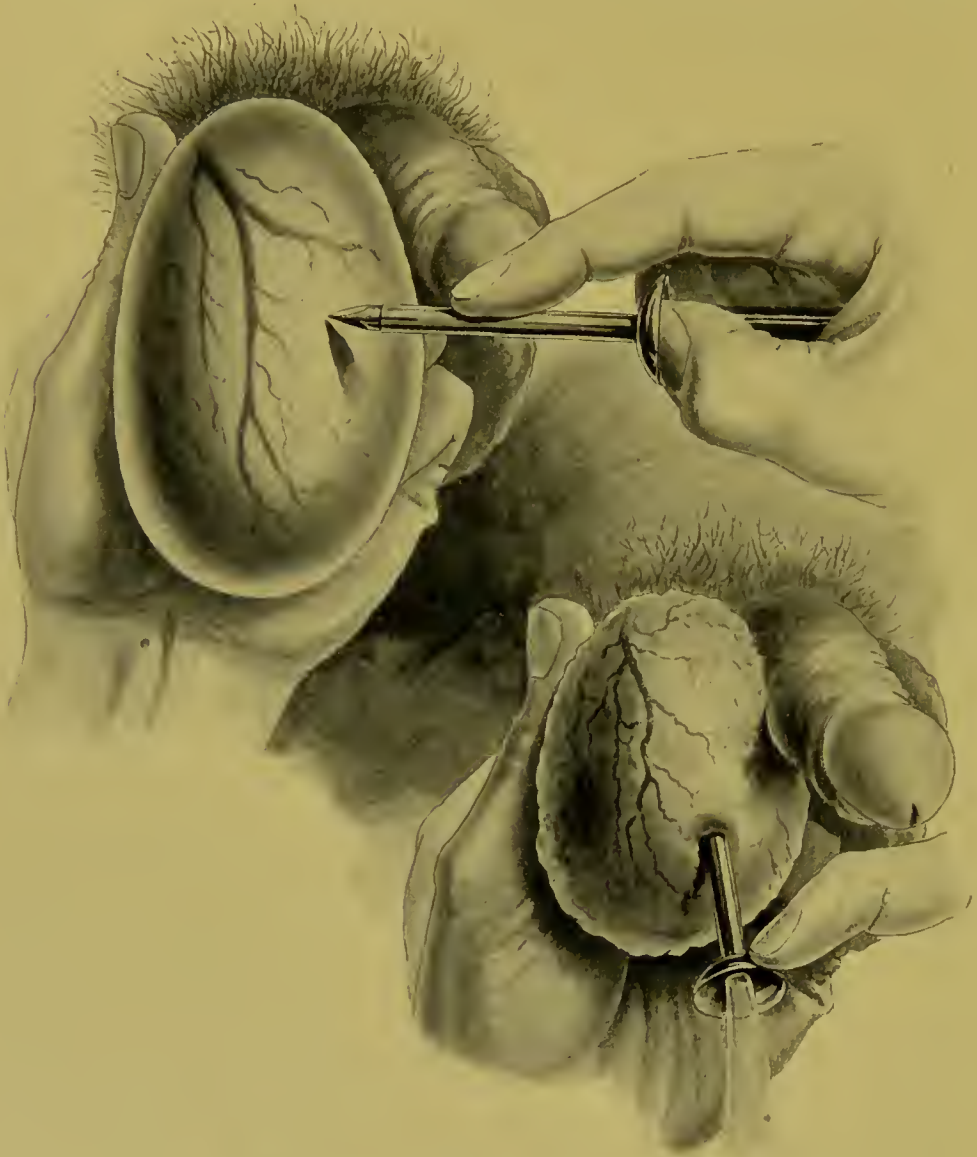


FIG. 105.—THE METHOD OF TAPPING A HYDROCELE. The upper figure shows how the trochar and cannula are held, and how the hydrocele is made tense. The lower one shows how the cannula is held when the fluid is escaping, and how the tunica vaginalis is compressed in order to empty it thoroughly.

placed over its open end; the walls of the tunica vaginalis are then vigorously rubbed together so as to smear the carbolic acid completely over their surface. The small puncture in the dartos is closed with salicylic wool and collodion.

The operation is not at all painful; the patient merely experiences a slight warmth at the time the fluid is introduced and this is soon succeeded

by a sensation of numbness. He should go to bed for 24 hours after the injection and have the testis supported. The injection is usually followed by some swelling unaccompanied by pain or signs of inflammation. A certain amount of fluid is effused, but this rapidly becomes absorbed and the swelling disappears. If possible the patient should be kept in bed until the swelling has almost gone, but recovery will proceed even if he goes about with the testicles supported by a suspensory bandage.

Excision of the wall of the sac.—The strictest asepsis is necessary here, and special care must be taken to see that the parts are thoroughly purified. The scrotum, pubes and penis are shaved and the latter is fastened to the skin on the opposite side by a stitch as for hernia (see Part VI., Sec. I., p. 450) so as to keep it out of the way. The tumour is grasped between the thumb and forefinger of the left hand slightly behind its centre, the skin is made tense over it, and a vertical incision is made extending from the upper to the lower limits of the swelling dividing the skin, dartos and fascia; this is steadily deepened until the thin tunica vaginalis is evident. The coverings of the testicle are now separated from the tunica vaginalis with a blunt dissector or the finger, care being taken not to puncture the hydrocele cavity until the whole of the tumour can be turned out of the wound with the testicle and epididymis forming the base of the swelling. It is well also to ascertain the position of the vas and to see that it is thoroughly cleared from the sac right down to the epididymis.

When the hydrocele has thus been isolated, the tunica vaginalis is opened with scissors, the fluid is allowed to escape and the whole of the parietal portion of the tunica vaginalis is clipped away as close to the testis and epididymis as possible. The portion of the tunica vaginalis covering the testis cannot well be removed, but, in order to avoid any possibility of secretion occurring from its surface afterwards, it is well to brush it over lightly with undiluted carbolic acid and then to wash away any excess of the acid with sublimate solution.

Great care must now be taken to stop all bleeding, because a considerable hæmatoma may form if oozing continues after the wound is closed and this would delay healing; it is impossible to apply direct pressure to stop this oozing. The wound is completely closed with a fine continuous button-hole suture, the incision being put slightly on the stretch by blunt hooks introduced at the upper and lower angles, and care must be taken in doing this to see that the edges of the scrotum do not curl in as they are very apt to do, and also that the stitches are not put too far apart, lest gaping should occur when the blunt hooks are removed. It will probably be unnecessary to remove the stitches if fine catgut be used as they will become absorbed. Should there be any doubt as to whether the oozing has ceased, a fine drainage tube may be introduced into the lower angle of the wound for 24 hours; this will not delay the progress of the case.

Dressings similar to those for the radical cure of hernia (see Part VI., Sec. I., p. 452) are applied and are left on for about five days, when a

collodion dressing is substituted and this is left on until it comes off spontaneously; if non-absorbable sutures have been used they should be removed at the first dressing. The patient may be allowed to get up at the end of the first week and should have the scrotum well supported by a suspensory bandage or by a mass of wool in the perineum kept in position by a St. Andrew's cross bandage.

(b) Congenital hydrocele.—Here the funicular process is open from the peritoneal cavity down to the bottom of the scrotum, and the hydrocele fluid is in direct communication with the peritoneal cavity. The aperture into the abdomen varies much in size; it may be large enough to allow the descent of a hernia or it may be a mere pin-hole. There is a distinct impulse on coughing if the communication be at all free, and in any case the fluid will return into the abdomen simply by the effects of gravity when the patient lies down; the rate at which this disappears may give some sort of indication as to the size of the communication.

Treatment.—These hydroceles are generally noticed very soon after birth, and the question of treatment will arise quite early. It is undesirable to perform a radical operation on infants or very young children, and it is obviously inadvisable to inject irritants lest they should find their way into the peritoneal cavity. On the other hand it is not an uncommon experience that, after evacuating the fluid with a fine trochar and applying evaporating lotions over the part, followed in the course of a few days by an efficient pad and bandage, the fluid does not re-accumulate, the walls of the sac become adherent and the communication with the peritoneal cavity becomes obliterated. If necessary the puncture may be repeated more than once and is best done with the exploring needle of an ordinary hypodermic syringe.

If this treatment be ineffectual, the surgeon should wait until the child is at least nine months old, and preferably until he is about two or three years of age, and then proceed to excise the sac. Excision is advisable for several reasons. In the first instance injection is out of the question because of the communication with the abdomen; in the second place, the aperture of communication may enlarge and a congenital hernia may result, and this is greatly facilitated by the distension of the inguinal canal, which results from the presence of a hydrocele traversing it.

Excision.—The incision is similar to that for the radical cure of hernia (see Part VI., Sec. I., p. 450); the cord is raised, the testicle drawn from the scrotum and the hydrocele sac identified, clipped off on a level with the epididymis below and stripped up from the other structures of the cord like a hernial sac as far as the internal abdominal ring. The rest of the operation is exactly similar to that for the radical cure of congenital hernia (see Part VI., Sec. I., p. 454).

(c) Infantile hydrocele.—Here the funicular process is open from the internal abdominal ring down to the bottom of the scrotum, but does not communicate with the abdomen. There is often an impulse on coughing,

as the upper end of the hydrocele extends into the inguinal canal, but this form of hydrocele differs from the true congenital form in that the fluid does not return into the abdomen.

Treatment.—Injection is not advisable here on account of the anatomical situation of the hydrocele. If the swelling be large, it may be punctured and evaporating lotion applied when the child is quite young and, if this fails to cure it, the child should be left until he is old enough, when the sac is excised completely. The treatment is practically the same as that for congenital hydrocele (*vide supra*).

(d) **Encysted hydrocele of the cord.**—Here there is an ovoid swelling along the cord usually extending downwards from the external ring and due to effusion of fluid into an unobliterated portion of the funicular process of the peritoneum. The hydrocele varies in size from a small marble to a large brazil-nut and in the former case is rounded whilst in the latter it is elongated or ovoid. When the swelling extends up through the external abdominal ring there may be a definite impulse on coughing, but the close connection of the cord with the tumour and the translucency of the latter will demonstrate the nature of the affection.

Treatment.—The hydrocele should be excised through an incision extending downwards from the external abdominal ring so as to expose it thoroughly. The parts are made tense over the tumour, which is then cut down upon layer by layer and the constituents of the cord are separated from the sac wall; the latter is then removed. The operation is very simple and healing should take place in a few days. Should there be a hernia present as well, a radical cure (see Part VI., Sec. I., p. 450) should be done at the same time.

Occasionally the hydrocele sac contains a milky fluid, and the condition is then termed *chylous or fatty hydrocele*. Here there is some communication between the lymphatics and the hydrocele sac and the condition is most common in those who are the subject of filaria. Excision is better than tapping and injection.

(e) **Encysted hydrocele of the epididymis.**—These are really cysts and not distensions of the tunica vaginalis or the funicular process. There are two forms of encysted hydrocele of the epididymis, one of which contains spermatozoa and is commonly called a *spermatocele*, and the other clear fluid without any spermatozoa. The cysts are very slow in development and seldom attain a large size. They are usually globular and may be multilocular and if large enough will show translucency unless the fluid be opalescent.

Treatment.—The cyst causes no trouble apart from the inconvenience due to its size, and therefore no treatment need be undertaken if it be very small. If however its presence causes the patient any annoyance, the best plan is to cut down upon it and excise it. Tapping followed by injection will also cure a good many of these cases.

(f) **Hydrocele of a hernial sac.**—Occasionally a hernial sac becomes obliterated at its neck and the fundus becomes distended with serous fluid and gives rise to a fluctuating translucent tumour closely resembling an encysted hydrocele of the cord.

Treatment.—This should be the complete removal of the sac followed by a radical cure of the hernia (see Part VI., Sec. I., p. 450).

HEMATOCELE.

In a hæmatocele the tunica vaginalis becomes filled with blood and the affection may either follow an injury or may occur in the course of a hydrocele of the tunica vaginalis.

TRAUMATIC HÆMATOCELE may follow severe contusions of the testis and scrotum, and a similar accident may occur when a vessel is punctured during tapping of a hydrocele and bleeding goes on into the hydrocele sac. In these cases the tunica vaginalis becomes rapidly distended with blood, there is generally a good deal of pain and the diagnosis is comparatively easy.

IDIOPATHIC HÆMATOCELE is more common, and generally results from giving way of delicate vessels in the thickened walls of an old hydrocele, so that hæmorrhage occurs from time to time into the cavity of the tunica vaginalis. The blood-clots on the surface of the tunica vaginalis become partially organised and the sac wall therefore becomes increasingly thick, the visceral as well as the parietal layer being affected. After a time calcareous salts are deposited in the imperfectly organised clots, so that ultimately a dense, calcareous cyst wall is formed. This may exert much injurious pressure upon the testicle, and the structures of the cord become adherent to the outer wall of the sac, the contents of which are blood-clot and serum or merely blood-stained serous fluid. The swelling closely resembles a hydrocele in shape and situation, but differs from it in the density of its walls, in the absence of fluctuation, in the greater weight, and in the absence of translucency.

Treatment. (a) **Of acute traumatic hæmatocele.**—The patient is put to bed, the testicle is supported, and cold is applied to the parts by means of an icebag or Leiter's tubes. Unless it be evident in the course of a few days that absorption of the clot is taking place, the best plan will be to make a small incision, evacuate the clot and drain the sac for a few days.

(b) **Of chronic idiopathic hæmatocele.**—The only treatment of any avail is excision and this may either take the form of excision of the parietal portion of the tunica vaginalis or removal of the whole of the tunica vaginalis combined with castration. Tapping followed by injection is quite useless. Laying open and draining or tapping the sac seems to possess no advantages over excision, except possibly that there is less risk of injuring the structures of the cord which are often intimately adherent to the sac wall, whilst the risks of sepsis are much greater than after excision;

the results are not so satisfactory as, if the wall of the hæmatocele be very rigid, it will not collapse properly. The difficulty of identifying the vas may easily be overcome by tracing it down from above, and hence in our opinion the proper treatment of a hæmatocele is excision on lines precisely similar to that of hydrocele.

In excising a hæmatocele the vas must first be carefully separated from the sac wall right down to the testis, after which the hæmatocele is isolated from its various coverings, its wall laid open, the clots turned out and the parietal portion of the tunica vaginalis clipped away completely.

Castration may be necessitated by the presence of a very dense calcareous sac wall which cannot be clipped away, and it may be done all the more unhesitatingly because the pressure exerted by the calcareous sac wall will probably have damaged the testis irretrievably. The operation here is quite easy, as the cord can be divided an inch or so above the swelling and need not be followed up into the inguinal region. It is well to excise an elliptical portion of the scrotum in performing castration in order to avoid leaving a large pouch in the scrotum in which blood may accumulate.

VARICOCELE.

This is the name given to a varicose dilatation of the pampiniform plexus, which is a very common affection about the age of puberty. Various causes are assigned to the affection. It is probably predisposed to by the great length of and slow circulation through the spermatic vein, by the constriction exerted on the veins at the external abdominal ring and undoubtedly by hereditary tendency. The fact that it is more common on the left side than on the right is supposed to be accounted for by the fact that the left spermatic vein lies behind the sigmoid flexure and so has pressure exerted upon it when the loop of bowel is full of fæces, and also that the vein opens at right angles into the left renal vein instead of obliquely.

Some patients have very large varicoceles without any symptoms at all, whilst others suffer much from a comparatively slight degree of the affection and it is probable that the neurotic element enters largely into these cases. The complaint made is generally of an aching pain in the back and groin, especially in the region of the genito-crural nerve; the patient is often alarmed lest the generative function of the testis should be impaired. It is however very rarely indeed that any real atrophy of the testis occurs as the result of a varicocele. The troubles caused by the affection are much aggravated in hot climates, and the presence of a varicocele prevents the sufferer from entering the services or from following occupations in tropical countries; for these reasons treatment may be called for, although there may be no actual inconvenience complained of.

TREATMENT. (a) **Palliative.**—When the patient does not desire an operation or when he has no wish to enter one of the public services

or to live in a tropical climate, only palliative measures are necessary and these chiefly consist in supporting the testis with a well-fitting suspensory bandage, keeping the bowels regularly open in order to prevent accumulation in the sigmoid flexure, and bracing up the parts by the employment of cold douches every morning. The patient should be reassured as to the likelihood of damage occurring to the generative function of the testis.

(b) **Operative.**—When for any reason an operation is desired, a complete cure can be effected by a very simple operation which has no risk if it be done aseptically.

Various operations have been introduced; the one we prefer is done as follows: The parts are shaved and disinfected in the usual manner, the penis is stitched to the skin of the opposite thigh and an incision about an inch long is made over the cord immediately below the external abdominal ring, the veins and the other structures of the cord being rendered prominent by grasping and making the skin tense over it. As soon as the fascia covering the cord is reached, the finger is introduced and the whole of the cord is pulled out of the small wound and thoroughly exposed with very little trouble. With a few touches of a blunt dissector the cord can be cleared from the external ring right down to the testis and the next point is to isolate the vas from the other structures of the cord. The spermatic artery and nerve go with the vas and it is usually well to leave one or two small veins in connection with this structure. The whole of the remaining mass of veins is then isolated, first above where the veins converge and join up into a few large trunks and where therefore the separation is easiest, and from this point they are easily stripped downwards as far as may be desired. The whole of this mass is then ligatured in two places and the intervening portion is excised. The distance at which the ligatures are placed apart, *i.e.* the length of the portion of veins excised, will be determined by the degree to which the testicle is pendulous; in the usual cases where the affected testicle does not hang unduly low, about an inch is quite sufficient. The simplest way of determining the amount is to tie the lower ligature first just above the epididymis and then, holding the upper part of the cord firmly in position, traction is made upon this ligature so as to pull up the testis and to see how much shortening is required. In removing the mass of veins a good quarter of an inch should be left beyond the ligature in order that the latter may not slip off. The ends of the ligatures are left long and are finally tied together firmly, so as to bring the two divided ends of the cord into apposition, and then cut short. By this plan the veins are entirely removed, and the testis is braced up and secured in its proper position. Finally all bleeding points are tied, the wound is sutured, and healing is complete in a few days; afterwards the patient will require a suspensory bandage for a few weeks, when he may be considered perfectly and permanently cured.

DIVISION IV.

THE SURGICAL AFFECTIONS OF THE BREAST AND THORAX.

SECTION I.—AFFECTIONS OF THE BREAST.

CHAPTER L.

DEFORMITIES, INJURIES AND INFLAMMATORY AFFECTIONS OF THE BREAST: SYPHILIS AND TUBERCULOSIS.

DEFORMITIES OF THE BREAST.

THE only deformity of the breast amenable to surgical treatment is the so-called “umbilicated nipple” which is scarcely a congenital deformity, as it may develop after puberty when the breast becomes filled with fat. In it the nipple lies buried at the bottom of the circular fossa and in advanced cases may give rise to much trouble from the accumulation of dirt, epithelium and secretion. As a rule however the depression is not great and the trouble only requires treatment because of the possible difficulty in suckling.

Treatment.—The minor forms of this condition are easily remedied by removing a crescentic area of skin on each side of the nipple with its concavity towards the latter and sufficiently wide to obliterate the fossa between the skin and the nipple when its edges are sewn together (see Fig. 106). When the nipple lies buried at the bottom of a deep pit this operation may also possibly succeed but if not, it will be best to remove the nipple, if it be causing much trouble, as continued irritation of it may give rise to serious consequences.

HYPERTROPHY OF THE BREAST.—This condition is not uncommon and one or both breasts occasionally reach an enormous size.

The affection generally increases steadily and it is said that sarcoma of the breast not infrequently follows it.

Treatment.—When the breast has reached a size that makes it a source of great inconvenience to the patient, there is nothing for it but to amputate the organ as no treatment will bring the hypertrophy to a standstill.

TRAUMATIC AFFECTIONS OF THE BREAST.

These are unimportant, and merely require treatment on ordinary principles. Contusions of the breast may set up chronic mastitis, and in some cases the history seems to indicate that malignant disease has followed directly upon injury.



FIG. 106.—PLASTIC OPERATION FOR "UMBILICATED NIPPLE." The crescentic shaded areas represent the portions of skin removed. The inner and outer edges of the crescents are sewn together.

INFLAMMATORY AFFECTIONS OF THE BREAST.

Inflammatory affections of the breast may be acute or chronic and may originate in the nipple or in the breast tissue itself.

INFLAMMATION OF THE NIPPLE.—Cracks and fissures and so-called "chapped nipples" are common during lactation and are not infrequently associated with some slight malformation of the nipple necessitating increased efforts on the part of the child in suckling. Imperfect attention to the toilet of the nipples after suckling is also probably an important cause, as cracked nipples are very liable to infection especially when the infant suffers from an aphthous mouth or purulent ophthalmia. The streptococcus, the organism of erysipelas, etc., easily find entrance through these cracks.

The fissures are generally multiple and radiate from the centre of the nipple, to which they may be limited; they more commonly however extend on to the areola. They give rise to intense pain, which is set up by the slightest touch; they bleed readily and soon become infected, and therefore the child in suckling may swallow not only blood but pus.

Treatment.—The most important points are prophylactic. Should the skin be tender or the nipple deformed, the patient should either avoid

suckling altogether or should not suckle the child too frequently, and the parts should always be thoroughly washed with boracic lotion afterwards and then carefully dried and dusted with boracic powder, which should be wiped away before the child again takes the breast. Should fissures be actually present, suckling should be abandoned, but, if the mother refuses to do this, the next best thing is to employ a suitable shield to fit the nipple through which the child may suck without much risk. In the intervals between suckling the fissures should be bathed with antiseptic lotions such as boracic acid or boro-glyceride. If the fissures refuse to heal under this treatment, lotions of sulphate of zinc or copper (grs. ij ad ʒj), may be employed, or each fissure may be touched with solid nitrate of silver; under these circumstances the surgeon should insist on suckling being abandoned. Should septic infection occur, the fissure becomes more tender, and red lines spread from it towards the axilla in which the glands become enlarged; small abscesses not uncommonly form along the course of the lymphatics, especially beneath the areola, and the general symptoms of lymphangitis are also present. The treatment is that for lymphangitis (see Part II., p. 175).

ACUTE MASTITIS.—This affection may make its appearance in infants almost immediately after birth and, if the breast be squeezed vigorously, as is commonly done by ignorant midwives, the congestive condition of the gland may pass on into true inflammation and actual suppuration may take place. In other cases suppuration may not occur, but the inflammation interferes with the proper development of the organ, especially the nipple. Acute mastitis may also occur at puberty but is then usually non-suppurative. Suppuration is most common however during lactation and is most frequent in primiparæ. In a large number of cases sore nipples have preceded the formation of the breast abscess and the infection has originated from them, the organisms spreading either along the lymphatics or perhaps more commonly along the lactiferous ducts; in other cases a general septicæmic condition is present and the organisms are probably deposited from the blood.

Treatment.—*In adults, prophylaxis* is very important; strict attention should be paid to cleanliness, and the breast should be washed with boric lotion every time after the child is suckled. Careful attention must be paid to the cleanliness of the linen and to the condition of the mouth and eyes of the infant, and special precautions must be taken should any crack or excoriation of the nipple exist.

Before suppuration is evident the breast should be well supported by a breast bandage in which the turns pass alternately over the opposite shoulder, and around the thorax (see Fig. 107) or, if it be very tender, it may be slung up by a large bandana handkerchief. The arm should be fixed to the side and suckling should be entirely discontinued. Fomentations and the other local measures for the relief of acute inflammation should be employed (see Part I., p. 3).

When pus has formed, as will be evident from the œdema and redness of the skin, from the length of time that the inflammation has lasted or from the presence of fluctuation, the abscess should be freely opened. In these cases it is of the highest importance that all recesses should be thoroughly opened up and drained, and in the majority of cases the patient should have a general anæsthetic. The incision should be free and made in a line radiating from the nipple; the finger is subsequently introduced so as to break down any septa that may cross the abscess cavity. These are particularly numerous in the breast as the pus burrows among its ducts and lobules. A large drainage tube should be introduced and the strictest antiseptic measures employed. It is quite useless merely to make an incision through the skin at the spot where the abscess is pointing without opening up the recesses in the cavity, as fresh abscesses and sinuses will almost certainly form.

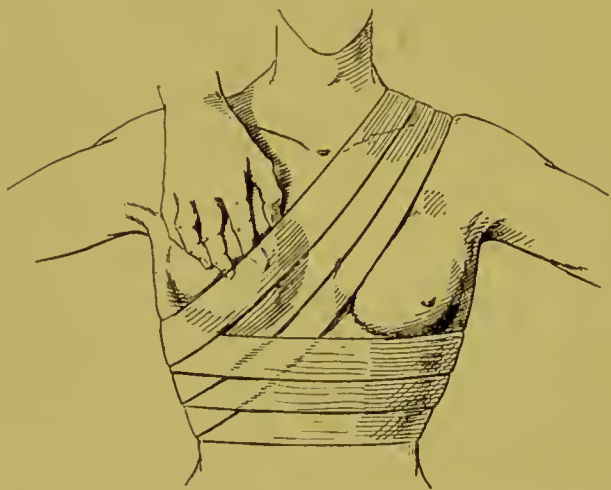


FIG. 107.—BREAST BANDAGE. The breast is pulled firmly upwards while a bandage is applied with turns going alternately over the shoulder and round the trunk.

Very superficial suppuration may occur in connection with a lobule of the breast and in these cases a single abscess forms between the breast and the skin and bursts through the latter if left alone. Incision and drainage of this cavity will lead to rapid healing.

It is not uncommon for a patient to present herself with a number of *fistule* in the breast resulting from a previous acute abscess followed by imperfect drainage. Unless these sinuses be opened up they will not heal, and the breast may become so disorganised as to be quite useless. Each sinus should be thoroughly opened up and the finger introduced so as to see that there is a free communication between them and that every recess is drained. A number of tubes should be passed through from sinus to sinus or into any recess, and the wound is dressed in the ordinary way. Syringing the sinuses is unnecessary and inadvisable and it will soon be found that under the above treatment the drainage tubes can be shortened

and gradually withdrawn until the sinuses heal one by one. When however the breast is completely riddled with sinuses, amputation of the gland may be the better treatment.

SUB-MAMMARY ABSCESS.—Acute abscesses occasionally form in the deepest lobules of the breast and spread into the loose cellular tissue beneath the gland instead of travelling towards the surface, and these give rise to the so-called *acute sub-mammary abscess*. A similar condition follows injuries, strains of the arm, etc., and results from a hæmatoma undergoing suppuration. In these cases the breast is raised *en masse* and projects forwards as an unduly conical organ, while, in the early stages at any rate, the skin over it though hot is not reddened. The symptoms of acute inflammation are present and œdema of the tissues around the base of the gland occurs; when this condition is found suppuration may be fairly certainly counted upon. The actual detection of suppuration is not at all easy as long as the pus is confined beneath the base of the gland and the best way of examining for it is to place the fingers of one hand at the margin of the organ, particularly below and to the outer side, and then to sharply depress the gland as a whole.

Chronic sub-mammary abscesses are fairly common. They arise in connection with a tuberculous deposit beneath the organ, frequently in the ribs themselves, and form fluctuating swellings beneath the mamma which if left alone tend to point at the lower and outer edge of the breast.

Treatment.—*In acute cases* the pus should be evacuated early by an incision at the lower and outer part of the gland—the situation in which it usually points. After the incision has been made, the cavity is opened up, explored with the finger and thoroughly drained.

The treatment of *the chronic tuberculous form* is similar to that for tuberculous affections of the ribs and consists in dissecting away the abscess wall and removing the affected area of the bone as well (see Chap. LIV.). The best way of exposing the tuberculous focus beneath the breast is to make a curved incision along the lower margin of the gland and turn it bodily upwards. This gives plenty of room to deal with the abscess and to resect the necessary portion of rib. After the operation the breast is replaced and the wound is stitched up.

CHRONIC INFLAMMATION OF THE BREAST.—This condition is quite common and occurs in two principal forms: in one the inflammation is limited to a portion of the breast, where it may form a tumour of considerable size; this is the true chronic mastitis: in the other form the inflammation attacks numerous lobules and after a time the breast acquires a granular feel from the thickening thus produced. This condition is known as chronic lobular mastitis and it may affect only one or two lobules, but is usually considerably diffused over the breast and is frequently present in both organs simultaneously.

(a) **True chronic mastitis.**—The majority of these cases follow injury or lactation, particularly at the weaning period. When the affection

follows injury it is probably due primarily to a localised hæmorrhage, but it may be the result of repeated slight injuries in large heavy mammæ or of undue pressure, as for example by tight stays or from playing any instrument such as the mandolin, the end of which presses upon the breast.

Symptoms.—There is usually comparatively slight, vague and variable pain. On examination a sensitive nodule may be detected, the outlines of the mass being diffuse and the tumour itself firm and elastic; this enlarges slowly as long as the original cause is in action. The swelling moves with the rest of the breast and the skin remains unaffected unless suppuration occurs. The axillary glands may be unaffected, but if enlarged they are usually of considerable size and the enlargement occurs much earlier in the disease than in the case of cancer. Suppuration occasionally occurs in these cases, when the pain and tenderness become more acute and the skin becomes adherent to the inflamed breast.

These cases are often most difficult to diagnose and are confounded with cancer of the breast or *vice versâ*. In cancer however the skin becomes pulled upon at a comparatively early period without any signs of inflammation and puckers when an attempt is made to push it gently up from the tumour, or an actual dimple is found due to the pull upon the suspensory ligaments of the breast which are involved in the cancerous growth. Carcinoma is also more defined and harder and forms a prominent mass under the hand when the palm of the hand presses the breast flat against the ribs; whereas in chronic mastitis, even though a tumour may be apparent to the fingers, no definite hard mass is felt on doing this. Chronic mastitis usually occurs in younger subjects than cancer, and the pain is only comparatively slight and is different in character.

Treatment.—The breast should be well supported by a handkerchief or still better by a breast bandage (see Fig. 107) and all causes of pressure or friction should be removed. The arm on the affected side should be kept in a sling and in bad cases even fastened to the side at first. If there be much pain, belladonna ointment or glycerinum belladonnæ may be smeared over the breast, but the best treatment is probably a succession of hot fomentations or poultices. The induration takes a considerable time to disappear but, as soon as it is yielding, pressure, best applied by strapping the breast, will promote its absorption. The organ should be well supported and strips of strapping about two inches wide are firmly applied from below upwards, beginning in the region of the sternum in front and extending well behind the posterior axillary line.

If there be the least doubt as to the nature of the swelling, the best plan is to cut down upon and remove the thickened mass, for after all this is the most effectual way of getting rid of the inflammatory area, while, if the mass prove to be cancerous, the diagnosis is made at a comparatively early period. We prefer to definitely excise the

swelling rather than to cut into it because, if it turn out to be malignant, there is a risk of diffusing the cancer cells over the wound if simple incision be employed.

(b) **Chronic lobular mastitis.**—This form of the affection may occur at any age and bears no definite relation either to lactation or to injury. It is perhaps more common in multiparæ who are approaching the climateric, but it may also occur at the age of puberty, and the nodules always tend to increase in size during the menstrual period. It is usually bilateral, but is commonly more advanced in one breast than in the other and as a rule the affection is only noticed by accident.

The breast is usually enlarged, and on palpation is found to have lost its soft, elastic character and to be unduly firm. If pressed against the thorax it feels granular, with numerous small nodules scattered throughout its substance; the axillary glands are seldom enlarged. Occasionally there is considerable pain, giving rise to the condition known as *mastodynia*, which is probably due to involvement of nerve-endings, but this is comparatively infrequent; when it occurs the patient has neuralgic pains beginning in the breast and radiating towards the neck, shoulder and back, often coming on in severe crises generally worse before the menstrual period.

The condition is usually readily diagnosed, the only difficulty being to distinguish it from multiple cystic disease of the breast of which probably it is merely the early stage.

Treatment.—There is comparatively little to be done, and as a rule it is sufficient to protect the breast from injury and to employ compression, which is best exercised by applying strapping and a bandage firmly over a large mass of cotton wool; for the relief of pain a belladonna plaster or glycerinum belladonnæ may be indicated.

Some surgeons, particularly in France, look upon this condition, especially when multiple cystic disease has developed, as a sort of epitheliomatous affection and advise excision of the entire organ affected, but to us such treatment seems unnecessarily severe. A free excision of the breast may be quite justifiable when severe mastodynia is present and the patient fails to derive benefit from local applications, combined with the use of the continuous electric current and provided that the condition of the pelvic organs reveals no cause for the pain. Even after this operation however the neuralgic pain is apt to persist or to appear in the opposite breast, and therefore a very cautious prognosis must be given.

MULTIPLE CYSTIC DISEASE OF THE BREAST.—Chronic lobular mastitis commonly ends in this condition. Sometimes limited inflammation of the lobule appears to lead to the formation of a fibro-adenoma. On examining a lobule which is the seat of mastitis the chief change in the early period is in the inter-acinous connective tissue, which undergoes marked proliferation. This may lead to atrophy of the epithelium, but proliferation of the epithelium of the acini not uncommonly

takes place and the latter become enlarged and microscopic cysts are formed. The great majority of these remain quite small, but one or two may attain a considerable size.

Treatment.—The question of excision of the breast arises in these cases and, as we have said, French surgeons strongly advise complete removal of the organ. There is however no definite proof that cancer develops from this condition and, unless definite severe pain or discomfort be caused, the procedure seems to us to be too severe. Any cysts of considerable size may be tapped and injected (see p. 501) or the affected portion of the breast may be excised.

TUBERCULOSIS OF THE BREAST.

This condition is not so uncommon as is often supposed, and many cases of chronic mastitis, especially those ending in suppuration, are really tuberculous in nature. The disease commences around the acini and may involve a considerable number of lobules. The glands in the axilla soon become enlarged.

Symptoms.—The onset of the disease is insidious. One or more irregular swellings appear and increase fairly rapidly; their centres soften and ultimately chronic abscesses and sinuses form. These sinuses have no tendency to heal, and the skin around becomes undermined in a characteristic manner. The condition is serious because it is likely to lead to destruction of the breast if not arrested by treatment, and it is also serious if the patient be still capable of child-bearing, for the milk may contain and convey the tuberculous virus.

Treatment.—If the condition occur during the child-bearing period, the best plan is to excise the entire breast, as it must always be a source of danger to the children and anything short of excision at this period of life rarely suffices to effect a cure. In older patients, in whom the disease is limited to a comparatively small area of the gland, it may be justifiable either to excise that segment of the organ or, if the patient objects strongly to such a procedure, to open up the sinuses thoroughly, scrape them freely and make them heal from the bottom by stuffing with iodoformed gauze.

SYPHILIS OF THE BREAST.

Syphilis in the breast may be met with in the primary stage. A *chancre* on the nipple is not at all uncommon from nursing a syphilitic child. It is a point of interest that, with rare exceptions, a syphilitic infant does not infect its own mother, although the latter may never at any time have displayed signs of syphilis, whilst a healthy wet-nurse will at once become infected. Chancres of the nipple are usually readily recognised, on account of the size of the sore and the induration of the base, together with the early enlargement of the axillary glands.

Condylomata are not uncommon on the breast in secondary syphilis and occur either about the nipple or the areola or, when the breast is very pendulous, in the fold of skin below it. *Gummata* have also been found in the tertiary stage, but they are rare.

Treatment.—The treatment of syphilis of the breast is similar to that for the disease elsewhere (see Part I., Chap. XII.).

CHAPTER LI.

TUMOURS OF THE BREAST.

MAMMARY tumours may be either simple or malignant; with the exception of fibro-adenoma the former are rare. Fibromata may occur, but are possibly the result of previous chronic lobular mastitis which leads to the destruction of the acini and leaves a fibrous mass which goes on increasing in size.

FIBRO-ADENOMA OF THE BREAST.

This is the most common benign tumour of the breast. Pure adenomata, that is to say tumours composed entirely of acini, are very rare; in the great majority the epithelial tubules are separated by a considerable amount of fibrous tissue, and the epithelial proliferation is probably secondary. In one form of fibro-adenoma the epithelial elements are chiefly arranged as small clusters of acini—the so-called “acinous adenoma”; whilst in the other the tubes ramify through the fibrous tissue; these tubules are dilated and have ramifications—the so-called “tubular or canalicular adenoma.” The fibrous tissue forming the bulk of the tumour is embryonic, or at any rate highly cellular, whilst in some cases it presents a myxomatous appearance and the tumour receives the name of “myxo-adenoma.” Occasionally the acini become dilated and form cysts, from the walls of which masses of young fibrous tissue covered with epithelium project into the cavity forming the so-called “intra-cystic growths.” Tumours possessing intra-cystic growths sometimes grow rapidly and may attain a considerable size. Sometimes the connective tissue is exceedingly embryonic and the growth of the tumour is very rapid and this variety has been termed “adeno-sarcoma,” but it would seem probable that the only true sarcomatous tumour of the breast is one which contains either no glandular elements whatever or only the mere remains of tubules.

These tumours are frequently encapsuled. They are generally single but they may be multiple, and they vary in size from a hazel-nut to an

orange. When they are large they are often lobulated in outline from the presence of cysts. The axillary glands are not affected. The growth usually occurs towards the periphery of the gland and is firm, elastic and not tender. There is often some increase in size during the menstrual period and the tumour remains stationary as a rule after reaching a certain size and indeed in some cases tends to disappear.

TREATMENT.—The only method of treatment is by removal, and it is well in all cases to recommend that this should be done immediately, not because the tumour itself is dangerous but because it may produce deformity if it increases in size, whilst its presence is always a source of anxiety to the patient; another reason is that, if seen in the early stage when there is no reliable history as to its rate of growth, it may easily be confounded with sarcoma, which naturally requires the promptest removal.

The operation is perfectly simple; a free incision is made over the growth until the capsule of the tumour is seen and, if this be opened through its whole length, the growth can be readily shelled out. It is perhaps best to remove the capsule as well as the tumour, so as to be absolutely certain that no recurrence will take place, for a fresh tumour may occur in the situation of the old one after simple shelling-out. The incision as a rule should be made in a line radiating from the nipple, but, if the tumour be situated in the upper part of the gland, in which situation it is important to avoid scarring, the growth may be removed by making a crescentic incision along the lower border of the breast, pulling the latter upwards and forwards and enucleating the tumour from behind. When the growth is deeply imbedded in the breast it is well to insert a small drainage tube for a few days after the operation, as otherwise blood is apt to collect in the cavity left and give rise to a troublesome hæmatoma which may interfere with union.

SARCOMA OF THE BREAST.

From 2% to 8% of breast tumours belong to this class of growth which is commonly of the round celled variety, but is occasionally spindle-celled. In the true sarcoma there is no growth of glandular tissue, but occasionally small portions may be found from accidental inclusion. The tumour possesses a spurious capsule and pushes aside and leads to atrophy of the surrounding breast tissue.

These growths generally occur in young women and are seldom met with after the age of thirty. They form rounded tumours which grow rapidly and may lead to ulceration of the skin over them, and they then fungate through the opening. In the early stages the affection is not easily distinguishable from fibro-adenoma, but the greater rapidity of growth, the rounded form of the tumour and the tendency to ulcerate through the skin soon renders the diagnosis certain. The growth does not tend to become generalised but in some cases, particularly in the round-celled variety, the axillary glands may become the seat of secondary deposits.

TREATMENT.—The appropriate treatment for sarcoma of the breast is early removal of the whole organ. Attempts to save any portion of the gland by removing the tumour and its capsule alone are very likely to be followed by recurrence.

The removal of the breast in these cases need not be nearly so elaborate an operation as for carcinoma (see p. 493). If the tumour be situated well towards the centre of the organ it is hardly necessary to remove the outlying lobules and, unless the growth be adherent to the pectoralis muscle, that structure need not be interfered with. It is well however to remove the pectoral fascia in all cases, because blood-vessels blocked with sarcomatous cells may ramify in it; the axilla need only be cleared out if there be enlarged glands in it.

CARCINOMA OF THE BREAST.

The most important tumours of the breast belong to this group, and in it there are two principal forms, namely those which commence in connection with the acini,—the ordinary “acinous carcinoma” and those which commence in connection with the ducts,—“duct carcinoma.” The ordinary cancer of the breast belongs to the group of carcinomatous tumours formerly distinguished as scirrhus; those, that is to say, in which there is great development of new fibrous tissue which contracts and presses on the alveoli and leads to atrophy of the epithelial cells. Hence the centre of these cancerous growths becomes almost entirely converted into a mass of fibrous tissue, whilst at the periphery there are large alveolar spaces containing epithelial cells with only a comparatively small amount of connective tissue between them.

The tumours commence in a lobule of the breast, probably from proliferation of the epithelial cells in the acini. These cells quickly push their way through the walls of the acini and spread into the surrounding tissues, most probably by getting into the lymph spaces and growing along them. This theory of the mode of spread of cancer of the breast is very important because it explains the distribution of the disease, and gives the surgeon a very definite indication as to the extent of tissue to be taken away in attempting to eradicate it. Since the researches of Heidenhain and Stiles have shown the true extent of the breast and the mode of distribution of the disease, and since extensive and methodical operations have been carried out on the lines indicated by these pathological researches, recurrence after operation has greatly diminished and in a large number of cases apparently no recurrence has taken place, at any rate for a very long period.

Cancer of the breast varies much in its malignancy. Sometimes it grows slowly and atrophies almost as fast as it grows. These are the typical cases of “atrophic cancer” and the patient may live for many years before the tumour ultimately kills her; some indeed have lived as long as twenty

years after the cancer has been discovered. Sometimes the growth extends with great rapidity and the patient dies a few months after the first discovery of the tumour. Every intermediate degree of malignancy is met with between these two extremes. Colloid cancer is also occasionally seen, usually in youngish women; this form of the disease is generally less malignant than the ordinary one.

The tumour is single at first, and it is only late in the disease that multiple growths are met with in the breast. From quite an early period, however, the lymphatics in and leading from the breast are found to contain cancer cells, and in a short time the nearest axillary lymphatic glands will be found infected also; it is said that this takes place within six months from the commencement of the growth in the breast. As the disease progresses, the infection spreads along the axillary glands into the glands in the posterior triangle and thence down into the mediastinum, whilst at the same time cancer cells are carried to distant parts by the blood-stream and secondary tumours may arise in regions with which there is no direct lymphatic connection.

It has been estimated that, after a cancer has lasted in the breast for about two years, there will be metastatic deposits in other parts of the body, but much depends upon the malignancy of the particular form of the disease. As the cancer cells spread towards the axillary glands they are apt to be arrested in the lymphatics, and this is a very important point to remember because it explains why it is not sufficient to remove the breast and the axillary glands; the lymphatic channels between the two must be removed also.

SYMPTOMS.—There is a tumour, seldom larger than a hen's egg and generally a good deal smaller, of stony hardness and ill-defined outline. The skin over the tumour is freely movable in the earliest stages and there is no retraction of the nipple but, as time goes on, the bands of fibrous tissue which connect the breast with the skin,—the “suspensory ligaments” of Astley Cooper,—become involved in the growth and are pulled upon by the contraction of the fibrous tissue, so that before long the tumour does not move absolutely freely and on pushing it to one side the skin tends to be drawn in or puckered although it may not be actually infected. The skin actually becomes permanently dimpled as the suspensory ligaments become more pulled upon. If the tumour be situated near the centre of the gland, the lactiferous ducts become involved and pulled upon and the typical retraction of the nipple occurs; this as a rule is greater on the side of the nipple towards which the tumour is situated. Retraction of the nipple however must not be looked upon as a very important sign; should the tumour be situated at the periphery of the gland, it may not occur for a long time, if at all, whereas, if the tumour be growing very rapidly and very little contraction be occurring, no retraction of the nipple may be met with, even though the tumour be actually in

the centre of the breast. On the other hand, retraction of the nipple is met with in chronic inflammatory conditions.

In time the growth spreads to and infects the skin, leading to the formation of a cancerous ulcer. In other cases the skin may be red and cedematous immediately preceding the ulceration and this may be followed by a diffuse development of cancerous nodules in the skin which run together and produce a hard, brawny, red patch,—the condition known as “cancer en cuirasse”; this is usually met with in the more rapidly growing forms.

A striking evidence of the great contraction that usually occurs in cancerous tumours of the breast is that the organ may actually appear smaller than its fellow, although the tumour may be of considerable size. Indeed in atrophic cancer the breast may disappear almost entirely. Even at a comparatively early period it will be found that the affected breast is not only somewhat smaller but that the nipple is higher up and the breast is less pendulous than its fellow.

Before long the tumour becomes adherent to the pectoral fascia and subsequently to the pectoralis major. Adhesion of the tumour to the fascia occurs comparatively early in some cases, at any rate when the tumour occurs towards the deeper part of the breast, and is usually detected by instructing the patient to stretch out the arm so as to render the pectoral muscle tense and then attempting to move the breast and tumour in the direction of the muscular fibres. This adhesion is of great importance because it implies that the whole of the pectoral fascia must be looked upon as possibly infected, and it is still more important when the muscle itself is actually involved because the arrangement of the lymphatics is such that they are likely to disseminate the disease throughout it.

The axillary glands will be felt to be enlarged at a fairly early period of the disease, but it must be borne in mind that they are probably infected long before they can be felt. The glands first enlarged are usually those along the edge of the pectoralis minor; the infection extends from this point up along the axillary glands and thence into those at the root of the neck.

Cancer of the breast is usually associated with a characteristic stabbing pain from a very early period, and it is generally this pain that leads the patient to examine the breast and discover the tumour. In a considerable number of cases however there is no pain at all, and the tumour is only discovered accidentally. In the early stages the patient remains in good health but, after the disease has lasted for some time, there is a definite weakness and loss of flesh, and a pale, earthy, cachectic look makes its appearance; this does not however imply infection of internal organs and may disappear after a complete operation.

As a rule the cancer remains limited to the breast first involved. but a tumour may be felt in the opposite gland in a certain number of

cases. It is probable that here the cancer cells have been carried across the middle line by the lymphatics and that the tumour in the second breast is really secondary to the original one and not an independent development. The condition usually occurs when the primary tumour is situated to the sternal side of the nipple. In some cases indeed the lymphatic vessels may carry the disease to the glands in the opposite axilla without infecting the breast in their passage.

TREATMENT.—Cancer of the breast should be removed as early and completely as possible. There may however be cases in which the disease is so advanced that there is practically no hope of eradicating it, in which cases the question of palliative treatment will arise.

(a) **Radical.**—However small the tumour may be, the operation in all cases should aim at removing the entire breast and its corresponding lymphatic area as high as the apex of the axilla. The latter step is necessary because the disease gets into the lymphatic system at a very early period and becomes distributed throughout the lymphatic vessels in which it may be arrested at any point; in any case it infects the nearest chain of lymphatic glands.

The lymphatic distribution in connection with the breast, according to Sappey's description, commences as small plexuses around the acini whence vessels run along the ducts, joining with others from the adjacent acini and forming plexuses around the ducts. These plexuses increase in size until they reach the nipple and thus lymph from all parts of the gland, even the most outlying lobules, is carried, according to Sappey, to the nipple in the first instance. In this region they form a plexus beneath the areola (the "sub-areolar plexus" of Sappey) and from this three or four large lymphatic trunks carry the lymph from the breast and the skin in its vicinity to the axillary glands. These lymphatic vessels run in the fat between the breast and the axilla in the neighbourhood of the lower border of the pectoralis minor.

Since the publication of Sappey's description it has been found by pathological and clinical investigation that there are other paths by which the lymph may be conveyed from the breast. Thus, lymphatics run from the plexuses around the lobules of the breast along the suspensory ligaments of Astley Cooper to join the plexuses in the deeper parts of the skin, and plugs of cancer cells have been found in the vessels in these ligaments. Another very important distribution is by vessels which leave the deeper surface of the breast and join lymphatic plexuses in the pectoral fascia, running thence to the axillary glands. This seems to be one of the commonest paths by which infection spreads in cancer of the breast. The lymphatics in the pectoral fascia communicate with those in the pectoral muscle and thus the disease may be distributed throughout that structure. It is also probable that lymphatics pass into the mediastinum along the perforating arteries at the inner aspect of

the mamma, and there is also reason to believe that a lymphatic communication exists with the opposite side across the front of the sternum.

In the axilla the chief lymphatic chain runs upwards along the lower aspect of and in close connection with the axillary vein to the costo-coracoid membrane, where the vein passes into the neck, and, if infection spreads past this point, enlargement of the glands in the neck appears behind the sternal attachment of the sterno-mastoid. The infection may also spread up in front of the vessels and nerves into the posterior triangle about the centre of the clavicle and a chain of enlarged glands may also be found extending upwards behind the axillary vessels along the course of the nerve of Bell, communicating eventually with glands in the back part of the posterior triangle of the neck. These three directions in which the glandular infection may spread from the axilla must be borne in mind during any operation.

As regards the extent of the breast, it has been shown, especially by Stiles, that the lobules of the organ extend in the fat for a long distance around the prominent part of the gland and may be found in the fat in front of the pectoral muscle almost as high up as the clavicle. They also extend well across the axillary space and well down below the breast. A large area of skin must therefore be removed in order to insure complete removal of the breast, and the skin left must be extensively undermined in order to remove the bulk of the fat between it and the pectoral muscle. The breast cannot be completely removed unless all the skin covering the prominent part of the gland be taken away also. Another reason for removing the skin widely is the risk of infection through the lymphatic plexuses of the skin; when the growth is beginning to involve that structure, an extra free removal of the skin is certainly necessary.

In planning his *incisions* the surgeon should pay no regard whatever to the possibility of suturing the wound at the end of the operation. As a matter of fact it is generally possible to bring the edges of the skin together after extensive undermining and pulling the flaps forcibly together, but this should be a purely secondary consideration, the primary one being the complete removal of the breast and lymphatic area. The pectoral fascia must also be completely removed and it should be remembered that this cannot be done satisfactorily without dissecting off a thin layer of the surface of the muscle. In many cases however the cancer is so firmly adherent to the pectoral fascia that there is every probability of infection of the muscle itself and in these cases a large portion, certainly the thoracic attachment of that muscle, should be removed also. This has the additional advantage of rendering it much easier to clear the axilla thoroughly. In fact it is very difficult to clear the fat and glands completely from the apex of the space without it. The fascia must also be thoroughly removed from the serratus magnus. Some surgeons advise

removal of the pectoralis minor as well in order to facilitate the clearing of the axilla but, if there be no reason to suspect infection of that muscle, it is quite easy to retain it and still clear the axilla satisfactorily; the subsequent movement of the arm seems to be better if this muscle be retained; the fascia over it however should be taken away.

The chief incisions for removal of cancer of the breast are shown in Figs. 108-112. They should be varied according to the seat of the disease and, in order to insure removal of sufficient skin from the neighbourhood of the growth, should generally be irregular in shape rather than the elliptical incision commonly recommended; in any case they must run beyond the projecting portion of the organ. When the skin has been divided, the incision should not be carried straight through to the deep fascia, but the skin should be undermined right up to the clavicle, the

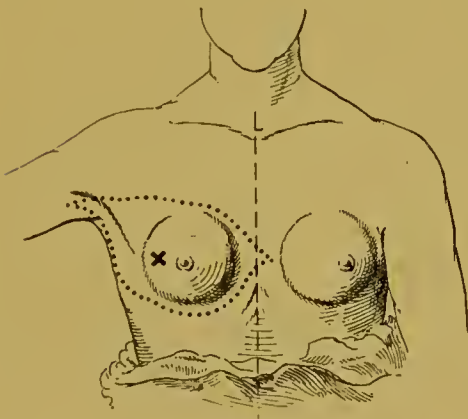


FIG. 108.—INCISIONS FOR REMOVAL OF A CANCEROUS TUMOUR SITUATED IN THE OUTER QUADRANT OF THE BREAST.

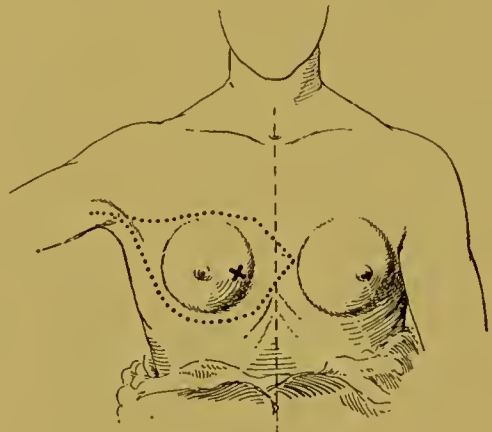


FIG. 109.—INCISIONS FOR REMOVAL OF A CANCEROUS TUMOUR SITUATED IN THE INNER QUADRANT OF THE BREAST.

incision being gradually deepened until the fibres of the pectoralis major are exposed when the clavicle is reached. This undermining of the skin has never led to sloughing of the edges in our experience and insures removal of all outlying portions of the breast. The incision is prolonged right out on to the arm beyond the insertion of the pectoralis major, and the skin is then similarly undermined at the lower part of the incision and down over the axilla until the edge of the latissimus dorsi is exposed. All bleeding points should be secured by the assistant as quickly as possible, and particular attention must be paid to picking up the anterior perforating vessels as they emerge between the costal cartilages.

The removal of the pectoral fascia and the pectoral muscle is undertaken after the surgeon has made up his mind how much of the latter structure is to be taken away. The fascia and the superficial layer of the clavicular origin of the muscle are dissected down, and then the fingers are sunk right through the entire thickness of the pectoralis and this is raised from the underlying structures and its sternal attachment

is gradually divided,¹ the vessels being seized as they are cut across. The breast, the pectoral fascia and the portion of the muscle to be removed come away as one piece and then the fascia over the serratus magnus is dissected back as far as the latissimus dorsi, avoiding damage to the termination of the nerve of Bell and also to the subscapular nerves. The breast, with the muscle attached to it, is now drawn over to the outer side and, after all bleeding points have been caught, a hot aseptic cloth is placed over the thoracic portion of the wound and the surgeon proceeds to deal with the axilla. The separated portion of the pectoralis major is cut across at its insertion into the humerus and the axillary vein is exposed below the lower border of the pectoralis minor well down to the outer end of the axilla and then the fat and glands are stripped up off the axillary and subscapular vessels and nerves with a suitable flat blunt dissector. In most cases the intercosto-humeral nerve must be removed

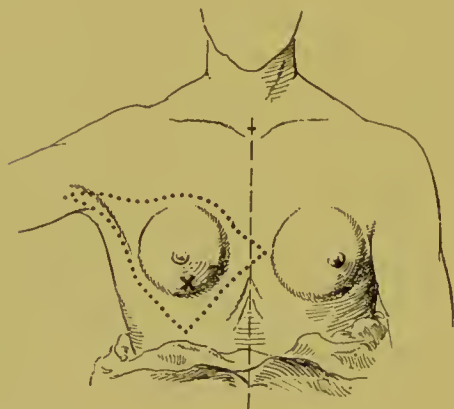


FIG. 110.—INCISIONS FOR REMOVAL OF A CANCEROUS TUMOUR SITUATED IN THE LOWER QUADRANT OF THE BREAST.

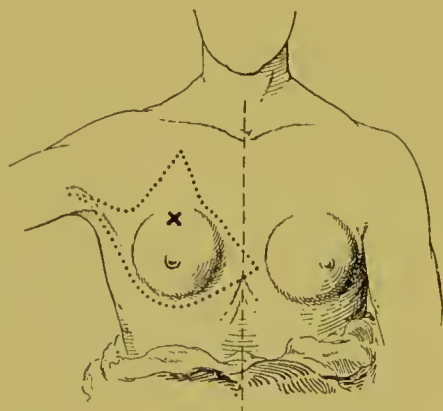


FIG. 111.—INCISIONS FOR THE REMOVAL OF A CANCEROUS TUMOUR SITUATED IN THE UPPER QUADRANT OF THE BREAST.

but, when the axilla is only slightly involved, it may be isolated and left behind and this will add to the patient's comfort.

Before going further in this region it is advisable to attack the apex of the axilla. The fascia is dissected off the pectoralis minor, the upper edge of the muscle is freed and then the dissection of the fascia is continued upwards until the vein is thoroughly exposed. The fat and fascia should also be removed from the under surface of the clavicular portion of the pectoralis major. This exposes the vein right up to the costo-coracoid membrane and all the fat and fascia are peeled thence from the vessels and nerves as far down as the lower edge of the pectoralis minor. Search should also be made behind the vein above, as glands may be met with in that situation. Finally the fascia is peeled back from the under surface of the pectoralis minor, commencing at its lower edge and taking care to save its nerve supply, and then, by pulling this muscle upwards

¹That is, if the extent or situation of the growth renders its removal necessary; if not, a layer of the muscle is dissected off with the pectoral fascia.

and downwards in turn, the complete separation of the fat and the glands beneath it is effected from above downwards, so that finally the whole of the fat and glands in the axilla come away in one mass attached to the breast and its lymphatic vessels. Special care must also be paid to the other two extensions of the fat and lymphatics in front of and behind the vessels and if any glands are found high up there it is well to open the posterior triangle of the neck by a separate incision and clear it out.

After everything has been removed, the skin is undermined in various directions as freely as may be necessary, when it will often be found that the edges of the wound can be brought together by using stout silver wire for stitches of relaxation (sec Part I., p. 155); this may allow the whole of the incision to be closed by a continuous silk suture.¹ In most cases no drainage is necessary but, should the patient be fat or should there be a large cavity left in the axilla, the best plan is to make a small button-

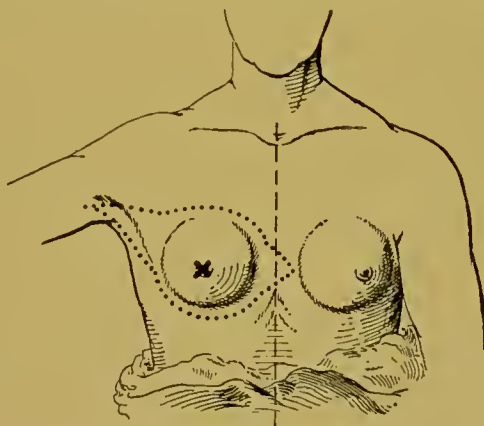


FIG. 112.—INCISIONS FOR THE REMOVAL OF A CANCEROUS TUMOUR SITUATED IN THE CENTRE OF THE BREAST.

hole through the skin over the lower and back part of the axilla and insert a tube through this. Large dressings are then applied and a mass of salicylic wool is fixed in the axilla so as to keep the arm projecting from the trunk at a right angle. The arm should be supported on a pillow and may be either rotated upwards with the hand fastened to the head of the bed or downwards and supported on a pillow. The patient frequently likes the position of the hand to be changed occasionally.

After-treatment.—When no drainage tube has been used, the dressings need not be changed for a week or ten days but, if a tube has been put in, the dressings should be renewed about the second day, when the tube may be left out. Possibly under these circumstances the dressing will need to be renewed again in about a week. Any silver stitches used for relaxation may be removed in about a week after the operation, whilst the silk stitches may remain for ten days or a fortnight. During the first three weeks the arm should be kept at right angles to the side by means of an axillary pad and after that time the patient may begin to use the arm,

¹ If not, the raw surface left can be covered by Thiersch's grafts ten days later.

carrying it in a sling when getting about, but whenever she sits down she should rest it on a table or the side of a chair so as to keep it well out from the side. At night she should if possible sleep with it at a right angle. We attach great importance to dealing with the arm in this way as it obviates the tendency to fixation to the side which otherwise occurs, and a patient treated in this manner will obtain the free use of the arm very much earlier than she would otherwise do. The results of these extensive operations are extremely good. It is quite uncommon for local recurrence to take place, and something like half the number of cases operated upon have remained free for several years.

Some surgeons advocate a still more extensive operation and in all cases remove the glands from the posterior triangle of the neck as well. If the infection of the glands in the neck be only slight, and especially if those in the lower part of the triangle only be affected, there is no objection to this, as it is readily done through an incision about an inch above the clavicle and parallel to it. When however enlarged glands cannot be felt in the posterior triangle and when the infection of the axillary glands is not extensive, it seems to us unnecessary to subject the patient to this operation, and we have rarely seen recurrence take place in the posterior triangle. On the other hand, if the infection of the glands in the neck be extensive, the chance of subsequent freedom from disease is so slight that it is questionable whether it is worth while operating.

We should say that *the cases unsuited for complete extirpation* are those in which there is extensive infection of the glands above the clavicle, those in which there is evidence of disease in internal organs, bad cases of "cancer en cuirasse" and cases in which the tumour has actually become adherent to the chest wall itself. Short of these conditions we advise extirpation, even though the local disease be very extensive, and in a certain number of cases a long period has elapsed without recurrence, in spite of apparently unfavourable conditions. Age does not form a great barrier against the operation; we have operated on patients up to eighty years of age who have done extremely well. At the same time of course extreme feebleness or very advanced age, especially if the growth be a typical atrophic cancer, would cause the surgeon to hesitate before operating. It is a very debateable point whether co-existing disease in both mammæ contra-indicates operation. If it be very extensive on both sides it is of course useless to expect a radical cure, but if the disease in the second breast is clearly secondary to that in the first and is not far advanced we should advise removal of both breasts. As it would be hardly possible to subject the patient to two operations of this magnitude on the same day, the second operation, which should be on the less affected breast, should be done after an interval of a week or ten days and the same extensive operation should be performed on the two sides.

By some authors atrophic cancer is looked upon as a form of the disease for which operation is unsuitable. From this view however we

would dissent. Not only is the operation desirable but the results are extremely favourable and, although a patient the subject of atrophic scirrhus if unoperated upon does not necessarily die for some years, she is very apt to have much suffering in connection with the spread of the disease, and at any time the tumour may take on active growth. There seems no reason whatever why the patient should not be freed of the disease simply because it is slow-growing, and although formerly, when partial operations were performed, rapid recurrence often took place, we have never experienced recurrence in these cases when a suitable extensive operation has been performed.

(b) Palliative.—When the surgeon is confronted with a case of cancer of the breast obviously unsuited for complete removal, the question arises whether anything can be done to relieve the patient and in the first place whether the breast should be removed even though there be no hope of eradicating the disease. Rapidly growing cancers of the breast left to themselves usually cause intense pain and trouble from the local spread of the disease in the breast and the axilla, and a patient will be freed from this by removal of the breast and death will be rendered much less painful if the local spread of the mischief be stopped. In cases of rapidly growing disease therefore, especially in youngish women, we would advocate free removal of the breast and axillary glands, even though there be indications that the whole of the disease is beyond complete eradication; and this we recommend in order to avoid the local ulceration and pressure symptoms which are sure to follow if the disease be left to itself. It is questionable however whether this is advisable if the skin be actually affected. In any case very free removal of the skin area should be adopted.

Oöphorectomy.—Much has been written lately concerning the value of oöphorectomy for inoperable cancer and, according to the published cases, the immediate effect of the operation has been striking in some cases, the tumour diminishing in size and in parts entirely disappearing, whilst the patient has improved in health and the local disease has remained quiescent. In our experience however a time comes in from six months onwards when the effect of the operation seems to pass off and recrudescence of the disease occurs, and we know of no instance in which the patient can truly be said to have been cured by the operation. The best results that we have seen have been in cases where the local disease has been eradicated as freely as possible simultancously with the oöphorectomy, but even here we have seen striking instances of the futility of the procedure. Something seems to depend on the thoroughness with which the ovaries are removed, for it must be remembered that the ovarian structure extends close up to the uterus, and the pedicle must therefore be secured absolutely at the uterus itself, both tube and ovary being removed on each side.

The conclusion we have come to concerning this method of treatment is that, should the patient be exceedingly anxious to have something more done and be otherwise in good health and should it be possible at the

same time to eradicate the local disease fairly completely, the operation combined with free removal of the local disease, may be done.

Thyroid extract.—Dr. Beatson, who first introduced oöphorectomy, advocated the long-continued administration of thyroid extract in increasing doses in combination with the operation. Other observers have claimed improvement from the use of thyroid extract alone. We cannot however say that we have ever seen any advantage in using this drug which seems to us to have value only as a placebo, the patient being happier while she is taking it and being under the impression that good may result. Any good that follows combined oöphorectomy and administration of thyroid extract seems to us to be attributable to the operation alone.

Recently the X-rays have been employed in inoperable cases, and in one or two instances distinct shrinkage of the mass has been noticed. We ourselves have had one striking case in which a skin infection as large as the palm of the hand completely disappeared under its use; in other cases it has had very little effect. The method however is still in its infancy and no reliable evidence is yet at hand. High-tension currents and other electrical applications seem to have no real effect at all.

PAGET'S DISEASE OF THE NIPPLE.

A peculiar ulcerative disease of the nipple was first described by Sir James Paget and is commonly spoken of in connection with his name. The disease affects the nipple and extends to the areola, the affected surface becoming raw, finely granular and discharging a copious, clear yellowish viscid fluid. This condition is not a true eczema, but is in reality a cancerous change in the papillary layers of the skin. In some cases this disease is associated with cancer of the breast, and so constant is the association between the two conditions that most surgeons advise complete removal of the breast in cases of Paget's disease, even though no tumour can be discovered in it.

TREATMENT.—In any case the affected nipple and a considerable area of the structures around should be freely removed, and it seems much safer from clinical experience to remove the breast and the glands as well. This should be done thoroughly, as already described (see p. 493), but, unless an actual tumour be felt in the breast, it is unnecessary to remove more than the lower mass of glands from the axilla, and the dissection need not extend upwards above the pectoralis minor.

CYSTS OF THE BREAST.

SIMPLE SEROUS CYSTS.—Cystic disease of the breast and cysts in connection with fibro-adenomata have already been described. Occasionally however a cyst is met with in the breast without any tumour in

connection with it and without an intra-cystic growth,—the so-called “simple serous cyst” of the breast. Cysts of this kind are supposed to arise after a localised mastitis leading to active overgrowth of the epithelium and blocking of the ducts. These cysts generally occur in the substance of the breast and form rounded, tense tumours in which it is seldom easy to get fluctuation on account of the tension under which the fluid is. They are painless and are generally single, but occasionally there are two or three large cysts as well as a number of small ones. On attempting to move the cysts the nipple becomes pulled upon owing to the intimate connection of the two structures.

Treatment.—Isolated cysts can generally be readily cured by first tapping them and then injecting a few drops of undiluted carbolic acid. As a result the cyst wall becomes inflamed and the cyst fills up, but the fluid becomes absorbed in a few days and a cure results. Any fresh cysts can be treated similarly as they arise, and thus an operation is avoided. Some patients however may wish to avoid all chance of having to undergo a repetition of the treatment and moreover there may occasionally be reason to suppose that the cyst forms part of a fibro-adenoma, and then the simplest plan is to excise the quadrant of the breast containing the cyst. If the breast tissue around be healthy, a radical cure will follow this procedure, but unfortunately it is not at all uncommon on cutting into the breast to find that smaller cysts are scattered throughout its substance and if the patient wishes for a radical cure there is no alternative but to remove the main mass of the breast. It is for this reason that we would advise a trial of tapping and injection, at any rate in the first instance, as the procedure is painless and saves an operation, whereas on the other hand the only true radical operation is complete removal of the breast, which is a comparatively severe operation. Excision of the affected area of the breast very often ends in disappointment.

GALACTOCELE.—By this term is understood a cyst containing milk more or less altered in character. The swelling is always formed during lactation and is due to dilatation of one of the larger ducts with partial obstruction to the passage of the milk. That the obstruction is only partial is proved by the fact that pressure on a galactocoele as a rule leads to a discharge of milk from the nipple and partial emptying of the sac. Sometimes these cysts follow injury and are then supposed to be due to rupture of the duct. They are innocent tumours; fluctuation can generally be made out in them.

Treatment.—The best plan is to excise the galactocoele through an incision radiating from the nipple. It is sufficient to shell out the cyst itself and a radical cure results. If excision be objected to, tapping and injection with carbolic acid may be employed, but the result is not nearly so certain in these cases as in the ordinary simple serous cyst.

DUCT PAPILLOMA AND DUCT CARCINOMA.

Papillomata may form small tumours projecting into the galactophorous ducts by a narrow pedicle and blocking them so as to give rise to a dilatation behind. They bleed readily and one of their symptoms is the escape of a bloody discharge from the nipple. On examining the breast in the early stages nothing may be discovered, but a small tumour can generally be felt later on beneath the nipple or areola. It is quite impossible to diagnose a duct papilloma from a duct carcinoma in the early stages; later on the carcinoma forms a larger tumour and follows a course similar to that of the ordinary form of cancer, though it is apparently less malignant.

Treatment.—In all cases the part of the duct involved should be excised if it can be localised, and if examination of the specimen removed shows it to be simply a pedunculated papilloma projecting into the duct, the surgeon may be content with the local removal; should there be any evidence that the epithelial elements are infiltrating the tissues around, however, the case will be one of duct carcinoma and the surgeon should at once proceed to remove the breast completely. If the case be seen at an early stage an exception may possibly be made to the ordinary rule of removing the axillary glands at the same time, but should the disease have extended beyond the wall of the duct or should there be any sign of enlargement of the glands in the axilla, the complete operation for cancer of the breast should be undertaken (see p. 493).

SECTION II.—*AFFECTIONS OF THE THORAX*
AND ITS CONTENTS.

CHAPTER LII.

FRACTURES OF THE RIBS, COSTAL CARTILAGES AND
STERNUM.

FRACTURE OF THE RIBS.

THESE injuries are most common during adult life; when growth is complete the ribs become less elastic and the cartilages more ossified and brittle, and fracture is therefore more likely to follow comparatively slight violence than in the young in whom the ribs are very elastic and bend without breaking. Fractures of the ribs are more common in men than in women and may be due to either direct or indirect violence. The seat of a fracture from direct violence corresponds to the point of application of the force, and the ends of the bones are driven inwards and the inner surface is more split up than the outer. Unless the violence be very great or the rib be fractured in more than one place, the elasticity of the bone causes it to resume its normal outline almost immediately, but before this occurs the sharp edges may cause laceration of the vessels or puncture of the pleura or the lung as they are driven in. The commonest cause of this fracture however is compression of the chest from before backwards or from side to side. The ribs are then fractured from indirect violence, being bent beyond their limit of elasticity and giving way at their weakest point. In antero-posterior compression, which is the commonest form of injury, the fracture occurs either about the mid-axillary line or at some point between that and the angle of the ribs. The tendency is for the broken ends of the bone to start outwards in this form of fracture, and adjacent structures are rarely injured except when the thorax is subjected to a crushing force. Fracture of the ribs may also occur from muscular action alone, as for example during parturition.

The ribs most commonly fractured are the middle six, the first three being protected by the clavicle and the thick muscular layers over them, whilst the last three are so mobile that they yield before the pressure. Occasionally the rib is incompletely fractured, generally after the application of indirect violence, the outer surface alone being broken through, and then the displacement is practically *nil*, the fractured ends being held together either by the periosteum or by a few osseous fibres on the inner surface of the bone. There is only slight displacement when a single rib is fractured, unless the bone be broken in more than one place, when one fragment lies inside the other.

SYMPTOMS.—There is a severe, sharp stabbing pain on breathing or coughing, with extreme tenderness on pressure, but in many cases no crepitus can be made out nor can any displacement be found. The best way to diagnose a fracture of the ribs when crepitus cannot be felt is to compress the chest from front to back; in a fracture sharp pain will be referred to the spot at which the bone is broken. Crepitus is often obtained by placing the hand flat upon the suspected area and making the patient breathe deeply or cough. It is never advisable however to cause the patient pain by making serious attempts to obtain crepitus, as a case suspected to be one of fracture of the ribs should be treated as if the diagnosis were certain. Should the ribs be merely bruised, the rest and support afforded by the treatment will relieve the pain.

COMPLICATIONS.—The chief importance of these injuries lies in the complications which may accompany them, and foremost among these are the injuries to the intra-thoracic organs. For example the pleura may be punctured and the intercostal artery may be torn and hæmorrhage may occur into the subcutaneous tissues and pleural cavity and a considerable *hæmo-thorax* may be produced; or air may escape from the lung into the pleural cavity,—*pneumo-thorax*—and when this occurs it is not uncommon for the air also to escape through the wound in the parietal pleura and become diffused in the subcutaneous tissues, giving rise to *surgical emphysema*. When the fractured ends perforate the lung there will be *hæmoptysis*. Hæmoptysis may also occur without any direct injury of the lung by the fractured ends, as a result of severe compression of the chest which causes actual *contusion of the lung* substance. Other viscera, such as the kidney, the liver, the diaphragm, the spleen or even the stomach may be wounded when the lower ribs are the seat of fracture. Among the more remote complications are *pleurisy*, which is not at all uncommon around the seat of the fracture; *pleuro-pneumonia*, when the lung has been damaged; *œdema of the lung*, which is commonest in old people in whom also *bronchitis* is frequent, especially when they have been previously subject to the affection. It very frequently happens that bronchitis is actually present at the time of the accident and the latter then merely aggravates the condition because the patient cannot properly empty the bronchial tubes, partly on account of the pain and partly

because of the fixation of the affected side of the thorax. If many ribs be broken, the affected side of the thorax may not move at all, and this is probably the main cause which brings about bronchitis as a direct result of the injury.

Fractures of the ribs usually unite firmly in three or four weeks, even though no particular steps may have been taken to secure coaptation and fixation of the fragments. It is very seldom that non-union occurs and, even should it do so, it is of little consequence in the expansion of the thorax provided that only one or two ribs be injured. The callus is small in amount; there may be little or no sign of the injury having occurred beyond slight thickening at the seat of fracture.

TREATMENT. (a) **Of the fracture itself.**—**When only one or two ribs are broken** there is no necessity to attempt to set the fracture, as a few inspirations bring the fragments into good position and the sound ribs will maintain them there. Even after puncture of the lung displacement is usually only transitory, but when a number of ribs are fractured there may be considerable displacement; even here, however, it is not necessary as a rule to attempt coaptation. Should the fractured ends be definitely driven in and penetrate the lung, it might be necessary to cut down upon the seat of fracture and deal with whatever condition is found in the most suitable manner; this however must be extremely rarely required.

Most simple fractures of the ribs heal quite well without anything being done for them, and some surgeons advocate rest in bed in the horizontal position for a few days, or for about a fortnight at the most, with an icebag or evaporating lotions applied to the parts to diminish the congestion, while morphine is given for the relief of pain.

Strapping the ribs.—In this country however it is usual to try to obtain a certain amount of fixation of the ribs, although this should never be carried to such an extent as to interfere with respiration, especially in old subjects. Fixation of the ribs is best secured by the application of broad strapping (see Fig. 113). Three or four strips usually suffice, as it is unnecessary to immobilise the entire affected half of the thorax. Some surgeons apply the strapping to the whole of the injured side, using strips about three inches broad, commencing over the false ribs below and extending up as high as possible without cutting into the folds of the axilla; complete fixation of the affected side of the chest however is to be strongly deprecated. The best plan is to apply one broad strip of strapping about



FIG. 113.—STRAPPING APPLIED FOR FRACTURED RIBS.

three inches in width over the line of the fractured rib commencing just beyond the middle line in front and extending to beyond the spine behind ; this should be put on during moderate expiration. Outside this may be applied two or three more pieces crossing each other somewhat obliquely over the seat of fracture. There is no doubt that a support of this kind relieves the patient and keeps the parts steady. No bandage should be put on, as this must necessarily interfere with the movements of the opposite side.

In old people, especially those who are subject to bronchitis, it is questionable whether any restrictive apparatus should be employed at all. At most two or three pieces of strapping applied as above directed should be used, and the patient should be propped up into the semi-recumbent position as early as possible ; morphine should also be administered. The use of strapping should be avoided altogether whenever there is any suspicion of the ribs being pressed inwards, as it will only serve to increase the damage done by their fractured ends.

After-treatment.—The patient need not be confined to bed after the first two or three days ; vigorous exercise must be prohibited for two or three weeks and the arm on the affected side should be carried in a sling. It is most important that old persons should be allowed to sit up as soon as possible as this is the best preventive of lung complications.

When many ribs are fractured, especially when the fracture is due to direct violence, strapping should be entirely dispensed with ; the patient should be kept in bed in the semi-recumbent or the most comfortable posture and as a rule the pain involved in breathing will cause the affected side of the chest to be fixed involuntarily and sufficiently to prevent undue movement. In a few days, when a certain amount of consolidation has taken place, and the patient is able to get up, strapping the whole of the lower half of the affected side in the classical manner from below upwards will give considerable relief and will enable the patient to get about provided there be no bronchitis. The administration of opium or morphine is very important in fractures of the ribs ; it eases the pain and diminishes cough, and hence it should be given freely from the first if there be no contra-indication such as renal disease, etc.

When the fracture is compound it must be treated on the ordinary lines for compound fracture (see Part III., p. 31). The injury is rare and in it the pleura is generally opened and some of the various complications already referred to are usually present and will require to be treated on appropriate lines.

Care must be taken in disinfecting the wound not to allow strong antiseptics to pass into the pleural cavity and also not to open up the rent in the latter unnecessarily. Should the injury have occurred some time before the surgeon sees the patient and should septic infection of the pleura have taken place, the ends of the fractured ribs should be excised and proper drainage of the pleural cavity established. This is practically similar to the treatment of empyema (see Chap. LIV.).

(b) **Of Complications.**—It is only necessary to refer here to lung complications, such as bronchitis or pneumonia, and to emphysema. The other affections, such as pneumo- and hæmo-thorax are considered elsewhere.

Lung complications, such as bronchitis or pneumonia, must be carefully watched for, and appropriate remedies, such as jacket poultices and the use of a steam-kettle, combined with the administration of expectorants and diffusible stimulants such as carbonate of ammonia, brandy, vinum ipecac., etc., should be employed as soon as the first symptoms appear, and the patient should be propped up as nearly in the upright position as possible. As the breathing becomes increasingly difficult from the engorgement of the right side of the heart, which will be denoted by lividity of the extremities and a full bounding pulse, venesection (see Part I., p. 4) from the arm to the extent of eight or ten ounces at a time will do much good and may be repeated if necessary in vigorous subjects; in those who are less able to bear the loss of blood, the inhalation of oxygen is very valuable if begun sufficiently early and may be maintained for a long time if it be doing good.

Surgical emphysema.—This seldom calls for any treatment as the emphysema rarely does harm, the air being sterile, and becoming readily absorbed as soon as its further escape into the tissues ceases. It rarely interferes with respiration, as it usually spreads from the seat of injury over the affected side of the thorax and it only makes its appearance in the neck when it escapes in large quantities. When the injury to the pleura occurs very high up, the air may extend upwards into the deep planes of the cellular tissue of the neck and may then so seriously interfere with respiration that it may be necessary to let it out. This can easily be done by puncturing the skin in several places with a tenotomy knife over the distended area. In doing this it is important not to withdraw the knife immediately the puncture is made but to turn it at right angles to the axis of the small incision so as to keep the aperture open and allow the air to escape. Small gauze and collodion dressings are applied over the punctures afterwards.

DISLOCATION OF THE RIBS.

The vertebral ends of the ribs are sometimes dislocated, generally as part of a very severe crush, and the accident is usually only recognised *post mortem*. Even were it recognised during life, it would be impossible to reduce the dislocation, and no special treatment apart from that of the severe injury that caused the mischief will be necessary.

FRACTURE OF THE COSTAL CARTILAGES.

Under this heading may be grouped both actual fracture of the cartilages and separation between them and the ends of the ribs. Fracture

is more common in advanced age when extensive calcification of the cartilage has occurred, whilst separation is commoner in adult life. It is generally due to severe direct injury, and the fracture usually occurs towards the costal end of the cartilage, those most frequently injured being the lower ones, the eighth more often than the others. The treatment is similar to that for fracture of the ribs (see p. 505).

DISLOCATION OF THE CARTILAGES FROM THE STERNUM.

This injury is extremely rare. In it the end of the cartilage projects forwards in front of the sternum ; occasionally it may be pressed behind that bone.

Treatment.—An attempt should be made to get the end of the cartilage into position, which is best done by making the patient lie upon the back with a firm narrow pillow or sandbag between the scapulæ and then take a deep inspiration. When the cartilage is dislocated behind the sternum, re-position is not easy to obtain without exposing the seat of injury by operation, when the cartilage can either be pulled back into place or, failing that, a portion may be excised. It is always advisable to secure re-position in this form of the injury, as otherwise the pressure of the cartilage in the mediastinum may give rise to troublesome symptoms. When re-position has been effected, the treatment is similar to that for fractures of the ribs (see p. 505).

FRACTURES OF THE STERNUM.

This injury is usually part of a severe crush of the chest. Fracture may occur at any part of the bone but commonly occurs at the junction of the manubrium with the gladiolus. It generally takes the form of a fracture-dislocation although it may occasionally be a true separation at the joint ; there is usually not much displacement and the lower fragment occupies a plane somewhat anterior to the upper.

Treatment.—Such displacement as occurs can generally be reduced by hyper-extending the upper dorsal spine over a large sandbag, when the two fragments are disentangled and can be got into position. Should attempts at re-position fail, there are two alternatives before the surgeon ; either the case may be left alone if the depression be very slight and not causing symptoms, or, if it is, the injured area may be exposed by turning up a flap, when the depressed fragment may be got into position and if necessary secured by a silver wire.

DISLOCATION OF THE XIPHOID CARTILAGE.

This process occasionally becomes bent backwards so that the tip presses inwards on the epigastrium and obstinate dyspeptic troubles, such

as pain and vomiting, may occur. Excision of the process has given complete relief to these symptoms and is therefore worth remembering. Should the displacement be recognised immediately it occurs, an attempt may be made to overcome it by manipulation, but this is not at all easy and, if it be impossible, a little time should be allowed to elapse in order to see whether it really causes trouble. If it does, it should be cut down upon and removed sub-periosteally.

CHAPTER LIII.

INJURIES OF THE THORAX AND ITS CONTENTS.

THE thoracic wall or the contents of the thorax may be injured separately or there may be a simultaneous injury of both.

INJURIES OF THE THORACIC WALL.

Fractures of the ribs, the costal cartilages and the sternum have already been considered (see Chap. LII.). There is little to say concerning other injuries of the thoracic wall itself, as the importance of the case depends upon whether or not the thoracic viscera are also damaged.

CONTUSIONS OF THE CHEST.—These are generally due to severe compression, as for instance in run-over accidents, from the impact of a spent bullet, from a fall, etc. The injury to the soft parts is comparatively trifling and consists generally of a variable amount of bruising with some laceration of the muscles. The importance of the contusion of the thorax is twofold: firstly, it may be accompanied by fracture of the ribs (see Chap. LII.); secondly, there may be severe intra-thoracic damage without any fracture. The relative frequency of visceral injury without fracture of the ribs depends partly upon the age of the patient and partly on the severity and rapidity of the injury. In young children the elastic ribs will bear severe compression without fracturing, and hence in them it is not uncommon to get severe injury to the thoracic viscera without fracture. The rapidity with which the blow is struck is also of importance, as slow compression of the chest wall gives rise to less damage than a sudden sharp blow, because in the former case the viscera have time to accommodate themselves to the altered shape of the chest.

The contents of the thorax without undergoing any visible injury occasionally suffer from a peculiar condition termed "concussion of the chest" or *commotio thoracica*, in which there is fatal collapse and on *post-mortem* examination no definite pathological lesions are found. This condition is commonly attributed to direct injury of the intra-thoracic

portion of the vagus, whilst some have ascribed it to paralysis of the sympathetic; it is also possible that it may be due to direct compression of the heart.

Treatment.—The first indication is to place the patient in the horizontal position or to tilt the body so that the head is dependent; artificial respiration will also be required until the power of normal breathing returns. Brandy or ether may be injected subcutaneously and friction applied to the surface. Stimulants should be given by the mouth when the patient is able to swallow.

WOUNDS OF THE THORAX.—These are generally divided into penetrating and non-penetrating wounds according as the pleural cavity is opened or not, and the seriousness of the wound is largely determined by this point.

(a) **Non-penetrating wounds.**—We shall here only deal with non-penetrating wounds, as injuries to the pleura are considered later (see p. 516). The only point of special importance attaching to non-penetrating wounds of the thoracic wall is the occurrence of hæmorrhage, which may proceed from the intercostal or the internal mammary artery. Strictly speaking these vessels may be wounded without penetration of the thoracic cavity, but in practice hæmorrhage from them is always associated with penetration.

Wounds of the internal mammary artery are of very rare occurrence and are generally due to stabs or bayonet wounds. The bleeding is very free and may take place either externally or into the pleura, the pericardium or the anterior mediastinum where a large diffuse hæmatoma may form. The artery may be wounded in any part of its course and the diagnosis is easy when the bleeding occurs externally but is difficult when the escape of blood is only into the thoracic cavity; it will then be determined by the position of the wound, the increasing anæmia, the signs of loss of blood and the indications of intra-thoracic pressure.

Treatment.—The vessel must be secured as soon as possible; unless this be done expeditiously the patient may die of hæmorrhage. The internal mammary arises from the subclavian at a point nearly opposite the vertebral and passes forward to the anterior thoracic wall down which it runs almost vertically about half an inch outside the border of the sternum superficial to the parietal pleura and the thoracic fascia. At the level of the fifth intercostal space the artery divides into its musculo-phrenic and superior epigastric branches.

The wounded vessel must be tied above and below in order to stop the hæmorrhage, and in the first instance an attempt should be made to secure the artery through the wound after enlarging it, but, as the space is comparatively small and as the tissues will probably be much infiltrated with blood, it is difficult to secure the vessel at the seat of injury without removing a portion of the costal cartilage. In such a case the best plan is to plug the wound temporarily and then to carry incisions upwards

and downwards from it, to lay bare the costal cartilage above and, after detaching the perichondrium, to remove about an inch of it from the sternum outwards. When the perichondrium and fascia have been divided the vessel may be secured; the lower end still remains to be tied however and in the first instance attempts may be made to do this from the wound already made. Should the cut end of the vessel have retracted behind the costal cartilage below the seat of injury however, as it not infrequently does, it is easy to secure it after removing a portion of that cartilage in a similar manner. It will probably also be necessary to deal afterwards with the results of the hæmorrhage, namely, hæmo-thorax or hæmo-pericardium and possibly pyo-thorax later on. In any case the wound should be thoroughly disinfected and drained and any complications that arise later must be appropriately treated.

Wounds of the intercostal artery are rarely met with and are commonly the result of stabs and gunshot wounds. The bleeding may occur into the thorax, outwards through the wound or in both directions simultaneously, whilst there is also extravasation into the cellular tissue of the thoracic wall.

Treatment.—There are two intercostal arteries in each space, the one a small and insignificant vessel running along the upper border of one rib and the other much larger accompanied by vein and nerve beneath the lower border of the rib above; this is the vessel usually wounded.

The obvious treatment is to open up the wound, find the source of bleeding and tie the vessel, but this is usually difficult unless a portion of the rib be resected or at least unless the periosteum be separated from the lower border of the rib beneath which the artery lies. Time will be saved in most cases by cutting down immediately on the rib above the wound, detaching the periosteum rapidly and fully, and then removing about an inch and a half of the rib. This exposes the intercostal vessel and the two ends may be picked up in forceps and tied. If there be any difficulty at all in doing this, the vessel may be under-run with catgut on a fully-curved needle. This is the only really satisfactory method of securing the vessel and, as excision of a portion of the rib leaves no weakness of the thoracic wall, there is no reason why the surgeon should be content with such clumsy expedients as passing an aneurysm needle around the rib and tying it over that structure so as to press the vessel against its lower border, or employing a tampon, which is very liable to be followed by sepsis.¹

(b) Penetrating wounds.—These are much more serious on account of the numerous complications that may accompany in them; in addition to

¹ A plan formerly recommended was to plug the wound by placing two layers of gauze over the opening and then poking the gauze through the wound in front of the finger so as to form a pocket or recess into which fresh gauze was packed as tightly as possible. An attempt to pull this plug out distends it laterally and expands the portion inside the chest somewhat in a mushroom fashion and so exerts very firm pressure.

wounds of the vessels already mentioned there may be injury to the lung, pleura, pericardium, heart, great vessels, diaphragm, œsophagus, trachea or thoracic duct. As a sequel to these injuries hernia of the lung may be met with or complications such as hæmo-thorax, pneumo-thorax, pyo-thorax or suppurative mediastinitis or pericarditis. All these conditions are dealt with separately.

Penetrating wounds of the chest may be due to stabs, gunshot wounds or extensive contusions. The prognosis depends on the cause of the injury and on the question of bleeding and sepsis.

Treatment.—In all cases the wound must be thoroughly purified in the ordinary manner, care being taken to see that no strong antiseptics run into the pleural cavity. In military surgery the possibility of the presence of a foreign body, such as a portion of clothing, must be remembered, and if present this should be found and removed. The patient should then be put to bed lying on the injured side and kept absolutely at rest, and it is important in these cases not to employ too vigorous measures to counteract the shock from which the patient always suffers, because the faintness produced by the severity of the injury is very valuable in stopping hæmorrhage, especially when the lung has been injured; free hæmorrhage from the lung, which might well prove fatal, may recur if stimulants be employed. Leiter's tubes or an ice-bag should be applied to the affected side of the chest outside the dressing. Ice should be given to suck and morphine may be administered hypodermically. The further steps in the treatment will be largely influenced by the question of the presence or absence of blood or air in the thoracic cavity.

Of wounds of the pleura.—*When the hæmo-thorax or pneumo-thorax is only slight* and does not incommode the breathing, the best plan is to close the wound into the pleural cavity by fine catgut sutures after thorough disinfection, and then either to close the external wound entirely or to introduce a small drainage tube into it for a few days, suturing the rest of the wound completely.

When there is considerable hæmo-thorax forming rapidly, it is well to enlarge the wound, to clear out the blood and clots and to search for the source of the bleeding. If this be an intercostal vessel it is easy to secure it (see p. 512). When however the exact seat of the injury is unknown, it is doubtful whether any good is likely to come of extensive operation, as the prolonged search necessary to expose the source of the bleeding and the difficulty of securing it when found are likely to prove too much for the patient's strength.

The treatment of *hæmo-thorax sufficiently severe to cause pressure symptoms* when the blood is unable to escape externally is dealt with later (see p. 517) as is also that of pneumo-thorax (see p. 518). When the pneumo-thorax occurs with an external wound however it seldom gives rise to any serious pressure symptoms as it finds its way out through the opening in the thoracic wall.

Of prolapse of the lung.—Prolapse of the lung through the wall of the thorax is a rare complication and may occur either at the time of the accident or subsequently. It is most commonly met with in extensive injuries, such as shell wounds, and is probably due to the glottis being closed at the moment the injury is sustained. The prolapsed portion of the lung becomes caught between the ribs and fixed there and undergoes considerable congestion from the pressure; it may ultimately become gangrenous.

Consecutive hernia, that is to say a hernia occurring through the seat of an injury some time after healing has taken place, is comparatively rare and results either from adhesion of the lung to the seat of the injury or from emphysema developing later or possibly from both causes combined.

Treatment.—If the case be seen immediately after the accident the treatment is easy; all that is necessary is to disinfect the surface of the lung thoroughly, free it and return it into the thorax, bringing the wound together over it. If however the case be not seen until some time has elapsed and firm adhesions have occurred between the opposing surfaces of the pleura, reduction is impossible and is inadvisable even could it be done. The prolapsed portion should be left *in situ* and allowed to slough off. The process may be hastened by tying a ligature tightly around the base of the prolapsed portion and cutting off the necrotic area.

Traumatic empyema.—This is a not uncommon complication after a penetrating wound of the thorax and when it occurs the sooner the thorax is opened and drained the better. The incision should be free and is best combined with resection of a rib (see p. 530). When the affection follows a wound it is probably best to enlarge this and to arrange for drainage through it; if however the primary opening be comparatively high up in the thoracic wall, it is well to pass a probe down through it to the lowest limit of the pleura about the posterior axillary line and to make a counter-opening in that position after excising a portion of the rib there also. A drainage tube can then be passed through from one opening to the other and the after-treatment will be similar to that for empyema (see p. 532).

Foreign bodies, such as bullets, fragments of clothing, etc., may be met with in the pleura or in the lung. If they remain aseptic, as bullets sometimes do, they may gravitate to the lowest part of the pleural cavity and there become encapsuled. If not, and if they are not removed, an acute empyema or an abscess of the lung may form, according to the position of the foreign body, and the pus may be discharged either through the wound or into one of the bronchi, in which case fatal septic pneumonia is likely to occur.

Treatment.—Should the object be opaque to the X-rays, it can be localised by them and cut down upon and removed, if it be in an accessible position. If it can be reached from the wound, the simplest

plan is to open up the latter and remove it by that route; in other cases it may be some considerable distance away and this is very likely to be the case with bullets, which can be localised by the X-rays, cut down upon and reached by the shortest route.

When the foreign body is a fragment of clothing and cannot be localised by the X-rays, the only thing is to open up the wound and examine the track of the sinus very carefully until the foreign body is felt. If it can be removed through the wound this should be done; if not, its exact situation should be ascertained and the thorax should be opened in the most suitable situation. Drainage must be employed subsequently. If the case be not seen until some time after the accident, either the foreign body will be quiescent or symptoms of empyema or pneumonia will have developed; the case then becomes either a pulmonary abscess or an empyema and must be treated accordingly.

INJURIES TO THE THORACIC CONTENTS.

These form a much more important group of cases and are very diverse in their nature; they may result from compression of the chest, from fractures of the ribs, or even from muscular action.

RUPTURE OF THE DIAPHRAGM.—This usually occurs on the left side and is generally part of a very severe injury, but it is sometimes occasioned by bayonet or gunshot wounds; it also has been known to occur from violent straining. Various abdominal viscera may find their way through the opening into the pleural cavity, giving rise to the so-called diaphragmatic hernia, which however is not a true hernia as it possesses no hernial sac.

The *symptoms* vary according to the nature of the injury and largely according to the particular structure that has passed through the rent in the muscle. Diaphragmatic respiration is much reduced or altogether abolished; there is great pain, which is increased on deep respiration or coughing; there is also considerable difficulty in breathing, and before long vomiting and various other symptoms set in which are due to the passage of some particular abdominal viscus through the opening, which may actually become strangulated later on. Symptoms of pleurisy develop after a short time, and the percussion note is markedly altered according to the nature of the organ that has passed through the opening. The *prognosis* is not good, but a certain number of cases have been operated upon with satisfactory results.

Treatment.—Operative interference takes the form of a laparotomy through an incision parallel to the border of the ribs and about an inch below them, so that the diaphragm is exposed at once, the exact condition of affairs can be ascertained, the prolapsed organ restored to the abdomen and the rent in the diaphragm stitched up. Riedinger has collected eight cases of operation for this injury which had

recovered. In actual practice the hernia apparently has been always approached from the abdominal cavity although it would seem possible that it might be easier to get at it through the pleural cavity after resecting two or more ribs.

Diaphragmatic hernia.—True hernia caused by protrusion of some of the abdominal contents through an abnormal opening in the diaphragm, is very rare but is nevertheless well known. In the majority of cases the condition has either been found *post mortem* or has been unexpectedly come upon in the course of a laparotomy for acute intestinal obstruction. The *treatment* will consist in an attempt to reduce the hernia after laparotomy and to suture the aperture in the diaphragm through which it has found its way.

INJURIES TO THE PLEURA AND LUNG.—These are the commonest visceral lesions in severe contusions of the chest; the air does not escape sufficiently quickly from the lung when the compressing force is applied, and consequently its tissue is torn. This is most likely to happen when the lung is full of air and the glottis is firmly closed at the time the injury is received.

The actual injury varies considerably. The visceral layer of the pleura may remain intact and blood may be extravasated into the lung tissue, a certain amount finding its way into the bronchial tubes and so becoming expectorated. In more severe cases however the lung substance may be torn to a considerable extent and the pleura ruptured over it, and then blood and air will escape into the pleural cavity and a pneumo-hæmothorax will be established. The bleeding will probably be profuse when the rupture is extensive, and the amount of air present will then be of secondary importance. There will be dulness over a large area of the pleural cavity and over the seat of injury. In the latter situation there will also be crepitations and there will be hæmoptysis. In mild cases there is merely some slight pain and cough and the patient spits up blood-stained mucus.

The *prognosis* depends entirely on the extent of the injury. When this is comparatively slight and there is no serious pneumo- or hæmothorax, recovery is usually rapid except in feeble or elderly subjects in whom the injury may form the starting point of pneumonia. When however there is extensive damage, extreme shock, profuse hæmoptysis and immobility of the affected side, the risk is very serious, not only from the immediate effects of the injury but also from the risk of infection of the extravasated material which occurs readily when the larger air passages are opened up. It would appear that infection does not occur when the terminal branches of the bronchi alone are in communication with the extravasated blood, as the bacteria are apparently filtered out of the air by the time it reaches that part of the lung.

Treatment. (a) **Of uncomplicated cases.**—The first essential is absolute rest. The patient should be put to bed and, after recovering

from the shock, should be propped up in the semi-recumbent position with a large ice-bag or Leiter's tubes applied to the affected side of the chest. If the dyspnœa be considerable, a hypodermic injection of morphine will probably relieve it greatly, and under this treatment most of the mild cases will recover, the sputum gradually becoming rusty in the course of two or three days and the case steadily clearing up. The patient should not be allowed to get up until all the physical signs have disappeared from the chest.

(b) **Of complicated cases.**—The most serious cases are those in which air or blood is present in the pleural cavity.

When there is hæmo-thorax, cold should be applied to the affected side of the chest in order to check the bleeding. Internal styptics, especially adrenalin chloride ($\mathfrak{M}\text{v-xxx}$ of a 1 in 1000 solution), chloride of calcium ($\mathfrak{Zi}$ per rectum), ergotone ($\frac{1}{100}$ th gr. hypodermically), and gallic acid (gr. xv), may be tried and will probably arrest the hæmorrhage unless a large vessel be wounded.

It is an open question whether any attempt should be made to open the thorax and try to secure the bleeding point. Should the hæmorrhage come from an intercostal or the internal mammary artery it would be an advisable procedure, but when it is due, as it commonly is, to tearing of a lung and oozing from its surface or when the bleeding comes from one of the larger pulmonary vessels, the chances of finding and arresting it after opening the thorax are almost infinitesimal.

The surgical treatment of persistent hæmo-thorax therefore will be mainly directed to the relief of pressure. If blood be poured out into the pleural cavity in large quantity it will exert injurious pressure upon the lung and interfere with breathing to such an extent that some amount of it must be removed. At the same time it is well not to be unduly hasty in removing the blood, as its pressure may act beneficially in stopping the hæmorrhage while, as soon as the bleeding stops, the fluid is rapidly absorbed from the pleura and the pressure diminishes.

If it be decided to relieve the intra-thoracic pressure, this should be done by puncturing the fifth or sixth intercostal space in the mid-axillary line with a large hollow needle. The patient should be in the horizontal position and it is well to make a small nick in the skin previously, after which the needle should be pushed into the thorax midway between the two ribs. The patient should be encouraged not to breathe deeply and the aspirating bottle should not be used; it is enough to allow the fluid blood to flow out and no more should be withdrawn than is necessary to relieve the pressure. It is better to repeat the tapping than to take away too much blood at one time.

Pyo-thorax will follow on hæmo-thorax when infection of the extravasated blood has occurred. Its treatment will practically be that of empyema (see p. 528).

Pneumo-thorax may complicate the hæmo-thorax—when it gives rise to the condition known as pneumo-hæmo-thorax—or there may be very little blood effused and so much air that the term pneumo-thorax alone suffices to indicate the state of matters. The condition may also occur apart from contusions of the chest as the result of other injuries; it is common in fractures of the ribs and penetrating wounds of the chest, in which case the lung collapses and air is drawn into the pleura at every inspiration and, if the opening be valvular, this does not escape on expiration so that a pneumo-thorax is produced. When pneumo-thorax results from rupture of the lung it is not uncommon for the opening to be valvular and for air to accumulate in the pleural cavity during inspiration, and considerable pressure may thus be exerted upon the lung. Pneumo-thorax may also occur in connection with tuberculous cavities.

As a rule suppuration does not occur when there is no external wound because the air is apparently filtered before it finds its way into the pleura; suppuration however is not at all infrequent when the pneumo-thorax is caused by a penetrating wound of the chest. The affected side of the thorax is more or less immovable, the heart may be displaced, and in severe cases the intercostal spaces may bulge considerably. There is a tympanitic note on percussion and the breath sounds are distant or absent.

Treatment.—The condition usually subsides without much difficulty unless it be due to an external wound or to an extensive rupture of the lung, and nothing need be done provided no great dyspnœa is occasioned. When this is marked however, when there are other symptoms of pressure or when the air is not rapidly absorbed, the pleural cavity should be punctured with a trochar and cannula and some of the air let out. The very strictest precautions must be taken to secure asepsis, otherwise an empyema will result. Pneumo-thorax occurring in connection with tuberculous disease is referred to later (see p. 538).

INJURIES OF THE PERICARDIUM.—These are necessarily very severe and generally cause death from shock. Injury to the pericardium rarely occurs alone, as the heart and great vessels are usually implicated and then death may be due to hæmorrhage as well as shock. In some cases however the parietal pericardium is injured alone as a complication of fracture of the ribs, sternum or costal cartilages; when the injury is due to a penetrating wound there is commonly a wound of the heart.

Treatment.—Injury to the parietal pericardium requires no treatment *per se*; this will be required however for the associated injuries. When it is associated with an external wound, the parts should be disinfected and, if there be any chance of sepsis, a drainage tube should be introduced and made to project just into the pericardial sac. The external opening of the tube should be covered by a piece of protective so as to prevent the entrance of air. A clean punctured wound how

ever should be closed immediately without drainage, careful watch being kept for sepsis; if this occurs it will take the form of suppurative pericarditis and the wound must then be opened up and the pericardium drained.

Occasionally a wound of the pericardium may be accompanied by severe hæmorrhage into the pericardial sac without the heart being wounded, and under these circumstances the case may prove fatal from the pressure of the effused blood upon the heart. If there be evidence of hæmorrhage of this kind, it is well in the first instance to insert a drainage tube through which the blood may escape and so relieve the pressure upon the heart. Should the pressure continue in spite of this treatment, it will be necessary to open up the wound widely and attempt to secure the bleeding points.

INJURY TO THE GREAT VESSELS requires no description as it is necessarily immediately fatal.

INJURIES TO THE HEART.—These may take the form of rupture of the organ, severe compression, punctures caused by stabs or bullet wounds or injuries from fractured ribs.

Rupture of the heart generally occurs from severe run-over injuries and is usually immediately fatal either from shock or from hæmorrhage; if death be not immediate it soon follows from hæmorrhage into the pericardium. **Wounds of the heart** are usually of the variety known as penetrating wounds and nearly 90% of all cases are said to be of this nature. The prognosis is extremely bad, particularly when the auricle is wounded; the least fatal cases are those in which the apex of the organ is involved. It is said that about 10% of all cases of wounds of the heart have recovered from the immediate effects of the injury, but death may occur subsequently from yielding of the scar and the formation of an aneurysm or from endocarditis, myocarditis or pericarditis. Secondary rupture of the heart is also known from giving way of the scar.

Treatment.—In a few cases in which the surgeon has been called in to a patient suffering from a wound of the heart, but in whom the hæmorrhage has not been very great, the wound has been opened up and the incision in the heart has been sutured. The organ is best got at by an incision along the fourth left intercostal space for about four or five inches commencing half an inch from the sternal margin; at the outer end of this a second incision is carried as far down as the seventh rib, a portion of the fifth costal cartilage is removed and the pleura is either pushed to the left side or, if it be impossible to avoid it, the two layers are sutured together (see p. 541) so as to avoid pneumo-thorax when it is punctured. This enables the clot to be turned out and the heart to be thoroughly exposed.

There appears to be no special difficulty or danger in exposing and suturing the heart, the chief point of importance being the extent of the wound in it. The sutures should be of fine catgut and should pass fairly deeply through the substance of the ventricle without taking up the endocardium. As soon as the wound in the heart has been sutured it will

probably be advisable to have recourse to stimulants, intra-venous infusion, etc., for the relief of the severe loss of blood (see Part I., p. 135). The pericardium is then closed, either entirely or after the introduction of a small catgut drain, which may be left out on the second day. Subsequently the administration of morphine and digitalis is very valuable.

INJURIES OF THE MEDIASTINUM.—These are generally part of very severe injuries and are apt to be followed by immediately fatal hæmorrhage. If the patient recovers there may be septic mediastinitis; this condition is treated separately (see Chap. LIV.).

CHAPTER LIV.

INFLAMMATORY AFFECTIONS OF THE THORAX AND ITS CONTENTS.

INFLAMMATORY AFFECTIONS OF THE RIBS AND STERNUM.

SEPTIC OSTEO-MYELITIS OF THE THORACIC WALL.—

Acute infective osteo-myelitis in its typical severe form seldom affects either the ribs or sternum, but a less severe or sub-acute form is not uncommon and occurs most frequently as a sequela of typhoid fever; it may also occur in children in connection with acute osteo-myelitis affecting other bones.

Symptoms.—These are similar to those of the disease elsewhere (see Part III., p. 173) but are comparatively sub-acute in character and result in necrosis of the portions of the ribs or sternum affected. The temperature is generally high and there may be rigors and septicæmic symptoms accompanied by the formation of a tender swelling over the affected area, the skin over which becomes œdematous and boggy and soon shows fluctuation. The sequestrum usually becomes loose in about six weeks and only involves a portion of the bone.

Treatment.—This is the same as for septic osteo-myelitis in general (see Part III., p. 175). The parts should be thoroughly exposed at the earliest opportunity, the pus evacuated and the wound left open. It is best not to remove any portion of the rib in the first instance, but to wait for the separation of the sequestrum, which is removed in the usual manner (see Part III., p. 187). In cases following typhoid fever however, the typhoid bacillus is very apt to remain in the medulla of the bone for a long period and, even if the sequestrum be removed and the inflammatory material apparently taken away, healing may not occur and fresh inflammation may be set up, and hence in these particular cases we are inclined to depart from the general rule and remove entirely the portion of the rib which is the seat of inflammation so as to make sure of removing the whole focus of disease.

SYPHILIS OF THE RIBS OR STERNUM.—This takes the form of gummata in the tertiary stage, and the sternum is very frequently affected. It generally occurs about the upper part of the bone, and, when it affects the ribs, the first rib is usually attacked near its junction with the sternum and the clavicle, and all three structures may be involved in the gummatous mass. As a rule it is not accompanied by any extensive necrosis.

Treatment.—In the early stages this is similar to that of gummata elsewhere (see Part I., p. 235), and the free administration of iodide of potassium in combination with mercurial treatment often causes the gummata to disappear without giving rise to any necrosis.

When necrosis has occurred and an open wound is present which will not heal after the administration of iodide and mercury, it is well to remove the sequestrum and the diseased bone around in a manner very similar to that for tuberculous disease (see p. 523). If this be done and if the anti-syphilitic treatment be kept up, the wound generally heals readily.

TUBERCULOSIS OF THE RIBS, COSTAL CARTILAGES AND STERNUM.—This common affection usually starts beneath the periosteum about the insertion of the intercostal muscles, but it may occur as a deposit in the bone which is often set up by injury; the deposits are not uncommonly multiple and may occur at more than one spot in the same rib or, more frequently, in several ribs one after the other. The most common seats are behind the posterior axillary line or close to the sternum, at the junction of the costal cartilages either with the ribs or with the sternum; the latter bone is also sometimes affected, generally at the junction of the manubrium with the gladiolus.

Symptoms.—These are generally very indefinite and the patient often does not realise that anything is wrong until a swelling is accidentally found upon the chest. In the early stages however there may be ill-defined thoracic pain followed after a time by an indefinite thickening over the affected area, which subsequently softens and gives rise to an abscess.

When the ribs are affected the abscess generally forms on the outer surface, but when it has attained any size it usually spreads to the deeper aspect of the bone and may lie not only between the rib and the superficial structures, but may burrow round between the rib and the pleura. This will give rise to a marked impulse on coughing in the tumour, and a mistaken diagnosis of localised empyema finding its way out through the intercostal space is not at all uncommon. When the abscess implicates the external surface of the rib only there is no such impulse on coughing. It is very important to remember that these abscesses may not point over the diseased area but may make their way forward between the intercostal muscles for some distance before they turn outwards, and therefore before operating a careful examination must be made to find

the thickened portion of the rib from which the abscess takes its origin. Another point to be remembered in dealing with these cases is that abscesses occurring in connection with caries of the dorsal vertebræ may also travel forward between the ribs and point in a similar manner and that therefore every chronic abscess pointing over the side of the thorax is not necessarily due to caries of the rib but may proceed from spinal disease.

Prognosis.—This depends largely on the treatment adopted. The abscess will ultimately burst through the skin if left alone, and an intractable sinus leading down to carious bone will be left and the condition may persist indefinitely, fresh sinuses forming one after the other.

When the sternum is affected the abscess usually points over the front of the bone. Occasionally however the disease is situated more towards the posterior surface, and the abscess may then point between the costal cartilages immediately to one side of the sternum; when this condition is met with the posterior surface of the sternum must be carefully examined with a probe in order to ascertain whether that is the situation in which the bone is diseased.

Treatment. (a) **Of tuberculous osteitis of the ribs.**—This is most satisfactory if it be sufficiently radical. The incomplete methods of treatment such as opening the abscess and scraping the bone, are of little value and, even though healing may occur under them, they do not in any way compare with the surer radical method which we advise. Occasionally it is found that the abscess heals after a small opening into it has been made, the interior scraped out and iodoform and glycerine injected as for a spinal abscess. (see Part I., p. 249). In these cases there is probably no necrosis present, but it is not a method of treatment that we would recommend.

The only really satisfactory plan is to excise the abscess completely along with the affected area of the rib, and this is comparatively easily done unless the abscess be very large. The swelling is exposed by raising a suitable flap, and the wall of the abscess is carefully isolated from the surrounding soft parts without opening it until the area of bone from which it springs is clearly defined. It is often found that, when the soft parts have been separated, it is possible to lift the abscess wall off the rib for some little distance and that the area of bone from which it takes its origin is comparatively limited.

The next step is to divide the periosteum at right angles to the long axis of the rib well in front of and behind the limits of the abscess; this structure is then peeled aside with a periosteum detacher from both surfaces and the rib is divided with cutting pliers clear of the abscess on both sides. It may then occasionally be possible to lift out the affected portion of the rib together with the unopened abscess, but usually the abscess cavity will have to be opened. If this be the case, the pus is rapidly flushed out of the wound with sublimate solution, the external

portion of the abscess wall is clipped away and then the affected portion of the rib can be lifted out so as to expose the periosteum on its inner surface. This is not infrequently covered with tuberculous granulations which should be scraped away, taking care not to perforate the pleura, and finally the surface left may be touched with undiluted carbolic acid so as to destroy any bacilli that may have escaped removal. A clean wound, probably without any tuberculous material in it, is left and this is now stitched up, but if undiluted carbolic acid has been applied to the surface it is well to put in a small drainage tube at one angle of the wound for two or three days; this should be removed at the end of that time as otherwise a sinus may remain for some time. Healing usually occurs by first intention and the patient is well in about ten days.

(b) Of tuberculosis of the costal cartilages and sternum.—

Here the principles of treatment are the same but the difficulty is greater. The abscess is dissected away and the costal cartilage is divided outside its limits and disarticulated from the sternum. If the latter bone be affected, a periosteum detacher is introduced behind it, the soft parts are gently pushed back, and as much of the side and posterior surface of the bone as is affected is clipped away with Hoffmann's forceps or cutting pliers, until the whole of the diseased area has apparently been removed. The deeper structures are then carefully scraped, and sponged over with pure carbolic acid and it is generally well to leave the wound open and to pack it with iodoformed gauze until it is granulating healthily everywhere, as there is not the same certainty in these cases that the disease has been entirely removed.

When the sternum itself is the seat of disease, the treatment is similar. The abscess is isolated as far as possible, the whole of its anterior wall is clipped away and, when the carious surface of the sternum is exposed, this is gouged or chiselled away well wide of the disease. If the latter be found to perforate the bone, the sternum should be gradually bored through and then enough bone should be clipped away with Hoffmann's forceps to get free of the disease. The wound is packed and allowed to granulate from the bottom.

When the patient comes under notice with a tuberculous sinus due to any of these causes the treatment is similar. The sinus is thoroughly opened up, dissected out if possible and the diseased rib or portion of the sternum is removed. After the soft tissues have been scraped and undiluted carbolic acid has been applied to them, the wound is left open and packed with iodoformed gauze.

INFLAMMATIONS OF THE PLEURA.

These may be divided into two large groups, non-suppurative inflammation of the pleura, or pleurisy, and the suppurative form, commonly known as empyema.

NON-SUPPURATIVE INFLAMMATION OF THE PLEURA.—

Pleurisy or pleuritis is essentially a medical disease, and the only point that we have to consider is the treatment of pleurisy with effusion. It may be mentioned that the majority of these cases of pleurisy with effusion occur in adults and are tuberculous in nature and that they seldom call for surgical interference.

Treatment.—When surgical interference is required, it is for the relief of dyspnoea or other symptoms of severe intra-thoracic pressure and takes the form of paracentesis thoracis. Unless symptoms of this kind be present, it is best to leave a non-purulent fluid to medical treatment. It is essential to avoid free opening of the pleural cavity in the majority of cases, especially when the case is tuberculous, as otherwise the chances of healing are slight.

Exploratory puncture of the thorax.—By this means the diagnosis of pleural effusion is confirmed; an exploratory puncture is also useful in ascertaining the nature of the fluid. The operation is simple and safe and in performing it it is important to have a sufficiently large and long needle. In a moderately stout person the normal pleural cavity may lie at least an inch and a half from the surface of the skin and this measurement will be much increased if the pleura be thickened. Hence the needle should be three inches long and should have a large bore, as otherwise it easily becomes blocked by flakes of lymph and there will be difficulty in drawing off fluid. The ordinary hypodermic needle is therefore of little value and the best plan is to employ a special exploring syringe with a large needle and a barrel arranged so that a higher vacuum may be obtained. It is well always to be provided with an ordinary aspirator and an aspirating bottle, so that, if necessary, evacuation of the fluid may be practised immediately after the exploration, if possible through the same needle.

The greatest care must be taken in disinfecting the skin and the instruments, as it is not infrequent for suppuration to follow exploration of a case of simple pleurisy with effusion. It is always well to employ a syringe and needle that can be disinfected by boiling; if the physician has only a hypodermic syringe at his disposal he should at any rate dip the needle into pure carbolic acid at least five minutes before the operation is performed so as to disinfect it, and he must also remember that it is essential for all the acid to be expelled from the syringe and the needle before the aspiration is performed, as otherwise coagulation of the fluid will occur in the needle and the flow will be stopped and any fluid withdrawn will be so cloudy that it may be mistaken for pus. Therefore boiled water should be syringed through the needle immediately before use.

When the effusion is not localised to a particular area of the pleura, the patient should be in the horizontal or semi-recumbent position well over the edge of the bed or couch, and an aseptic towel should be placed beneath him, the skin disinfected, and then the needle should be

introduced through the sixth or seventh intercostal space in the mid-axillary line. If a large needle is being used, it will be best to make a small puncture through the skin with a tenotome, as this not only allows the needle to pass in more readily but it avoids the risk of carrying epidermis and bacteria in from the cutaneous surface. No anæsthetic is necessary, but in a nervous patient a few drops of an 8% eucaïne solution may be injected hypodermically; freezing should be avoided as the skin becomes hard and resists the needle. The forefinger and thumb of the left hand are used to steady the parts over the intercostal space as the needle is introduced, and the latter is inserted by a single sharp thrust immediately above the upper border of the rib, the depth to which it is to go being fixed beforehand by placing the forefinger upon it at a suitable distance from the point, much as for puncturing a hydrocele (see Fig. 105). If the surgeon be careful to avoid striking the rib in doing this the introduction of the needle causes only trifling pain. The exhausting syringe is then attached and the fluid is withdrawn for examination. Should this turn out to be purulent and should there be no symptoms demanding immediate evacuation, it is well to wait 24 hours and to submit the fluid to bacteriological examination as this may have an important bearing on treatment.

Paracentesis thoracis.—When it is determined to evacuate the fluid from the chest, this should be done by simple paracentesis if the fluid be serous; if it be purulent however this is not a good method. It is true that in the early stages of pneumococcal empyema, when the fluid is just becoming purulent, its removal by paracentesis may suffice for a cure, but free evacuation and drainage are required in the majority of cases. It may however be of use as affording temporary relief when the surgeon is not prepared to undertake incision and drainage immediately, and it may also be useful when there is pus in both pleural cavities and the surgeon therefore prefers to incise and drain one side at a time, the other being aspirated sufficiently to relieve the urgent pressure symptoms.

The site of the operation is similar to that for exploratory puncture (*vide supra*) and the ordinary aspirator with an evacuating bottle should be used. A cannula of fairly large calibre may be employed and it is essential to see that its point is sharp; it is usually well, particularly in nervous patients, to give a hypodermic injection of eucaïne at the seat of puncture. As soon as the cannula is in position, the trochar is withdrawn and the bottle is attached. It is important not to keep the vacuum in the bottle too high, as otherwise the rush of fluid may dislodge masses of lymph which may block the needle, or the lung may be sucked against the point and either plug it or be punctured and bleed freely. The best plan is to keep the exhaustion at such a point that the fluid runs steadily and fairly slowly and this allows the intra-thoracic organs to accommodate themselves to the altered conditions. If the flow be arrested, it will probably be due to lymph blocking the orifice of the cannula, and a plunger several sizes

smaller than the cannula should be passed down the latter so as to unblock it. The reason for using a small plunger is that it can be made to push the mass of lymph away and may be left *in situ*, so as to keep it from falling back over the orifice of the tube as it would very probably do were a plunger used that entirely fitted the cannula and which therefore must be removed before the flow can be re-established.

Paracentesis must be discontinued should the patient faint, should there be persistent cough or should hæmoptysis occur. It is well to desist, for a time at any rate, if the fluid becomes blood-stained. When it is unnecessary to withdraw the whole of the fluid, the aspiration need only be carried to the point when the flow becomes scanty and intermittent and when the pressure symptoms are relieved. After enough fluid has been withdrawn, the aspirator is detached from the cannula, the thumb is placed over the end of the latter, the tissues are pinched up around its shaft and the cannula is withdrawn. The small puncture is sealed by a collodion dressing.

SUPPURATIVE PLEURISY or EMPYEMA.—This is a common affection; its precise characters depend largely upon the nature of the bacteria causing the suppuration. A great variety of these organisms have been found in suppurative pleural effusions. In children the most common is the pneumococcus, in adults, the streptococcus, but combinations of the two are also met with. Occasionally the infection is staphylococcic; sometimes putrefactive organisms are present, especially when the condition is associated with gangrene of the lung. The tubercle bacillus is found in a considerable number of instances. These latter cases clinically are chronic and should be considered separately.

The symptoms and diagnosis of purulent pleural effusions lie essentially within the province of the physician. The symptoms at the onset may be severe and characterised by rigors, sweats, emaciation, increasing anæmia, hectic temperature and the typical physical signs of fluid in the chest. The symptoms will continue unless the pus be evacuated and may be accompanied by signs of severe pressure, and the inflammation of the pleura will persist and give rise to increasing thickening, so that before long the lung becomes so bound down to the thoracic wall, especially in the vertebral groove, that even after removal of the fluid there is no possibility of its expansion. From this point of view alone it is most essential that the pus should be evacuated as soon as possible because the only way in which healing of the cavity can take place if the lung fails to expand is by falling-in of the chest wall, which is a very slow and imperfect process; therefore the chances of healing without some severe surgical interference are extremely slight.

Acute purulent effusions are rarely absorbed spontaneously, but it is said that those due to the pneumococcus occasionally are. If the condition be allowed to persist unrelieved and the patient lives, the tendency is for the pus to find its way through the thoracic wall and, although this may occur anywhere, it is generally said that the most common

spot at which it finds its way to the surface is in the fifth interspace in front, just external to the margin of the pectoralis major. Occasionally it finds its way into the bronchi and is discharged through the air passages.

The pus is not usually diffused throughout the whole pleural cavity. General diffusion may occur when septic material has been introduced into a healthy pleura and in other cases where very rapid inflammation and suppuration occur, such for example as infection after puncture of purulent lung cavities or rupture of a sub-diaphragmatic abscess through the pleura. Generally however the lung is adherent to the parietal pleura in parts and in the majority of cases the pus accumulates over the lower lobe of the lung with adhesion of the pleura above, so as to leave the upper part of the pleural cavity healthy and unadherent and with the lung expanding satisfactorily. Most empyemata are therefore circumscribed, but frequently the whole of the lower part of the thorax is converted into a suppurating cavity.

In other cases the collection may be much smaller in extent and may take the form of a typical localised empyema. According to Godlee there are three classes of this affection: 1. When the pus is contained in a cavity between the outer surface of the lung and the costal pleura; 2. When the pus lies between the diaphragm and the base of the lung; and 3. When it is confined to the fissure between two contiguous lobes or lies between the lung and the mediastinum. The exact localisation of the pus is determined partly by medical physical signs and partly by puncturing with an exploring needle, and in some of these cases it may be more or less a matter of chance whether the pus is hit or not; the greatest difficulty may occur in discovering the situation of the abscess, especially when it lies between the lung and the mediastinum.

Treatment.—There is no question that in acute cases the sooner the fluid is evacuated the better and this must be done by free incision and not by paracentesis; the case in fact should be looked upon as an abscess and should be treated accordingly.

(a) **Of non-localised empyema.**—In operating upon an empyema the first question is as to the anæsthetic to be employed. Chloroform should always be given in preference to ether, as the latter may cause violent coughing, and great difficulty may be experienced from the accumulation of mucus in the tubes which will still further diminish the already insufficient breathing capacity. In some cases the pressure symptoms may be so severe that it is inadvisable to administer a general anæsthetic at all and under these circumstances local anæsthesia by Schleich's infiltration method (see Part I., p. 123) should be employed. A simpler solution of the difficulty however is to have recourse to simple paracentesis thoracis first in order to relieve the severe pressure symptoms and then to incise and drain the pleural cavity in the ordinary manner in a day or two, when the patient has recovered from the embarrassment to breathing.

The position of the patient is of some importance and is determined to a large extent by the spot at which the incision is to be made. If this is to be in the sixth or seventh space in the mid-axillary line the patient should lie flat upon the table or bed, being drawn well to the edge; the surgeon can then work easily sitting down and facing that side of the thorax. If however the incision is to be made in the ninth space just external to the angle of the scapula¹—which is the most dependent spot when drainage is likely to be wanted for some time and is also the lowest spot at which the pleural cavity is most certain to be hit off without danger of the track becoming too oblique from the upward protrusion of the diaphragm—it will be necessary to turn the patient somewhat over on to the affected side and the surgeon will then face the sound side and operate leaning well over the patient, who should never be turned on to the sound side as otherwise the respiration might be seriously hampered.

The parts should be rendered aseptic in the usual manner, and the whole operation must be conducted aseptically as, although bacteria are present in the abscess cavity, it is advisable not to introduce any fresh ones from without. Those in the pleura have probably largely lost their virulence, and experience has shown that with free drainage they quickly die out. This is most important in pneumococcal cases and in the chronic cases due to the tubercle bacillus.

Much discussion has taken place as to whether the opening should be made through the intercostal space or whether a portion of rib should be removed as well. In favour of going through the intercostal space it is urged that in many cases there is quite enough room, especially when the chest is bulging, and that, although removal of a rib may be of temporary advantage, it does not really give rise to any more perfect drainage because regeneration of bone occurs rapidly and the opening becomes small. This is quite true in many cases in children from whom the periosteum is not removed, but at the same time a much better opening is obtained by resecting a portion of the rib for the immediate purposes of the operation, because the surgeon can thereby introduce his finger into the pleural cavity and explore it thoroughly, and moreover in

¹An incision in the fifth, sixth, or seventh space in the mid-axillary line is no doubt extremely convenient for reaching the pleural cavity as the ribs are almost completely uncovered by muscle; at the same time this is not the most dependent part of the pleural cavity either when the patient is lying down or sitting up, and it is not infrequently necessary to make a counter-opening subsequently about the ninth interspace in the scapular line so as to drain the most dependent part of the thoracic cavity. Although the ribs are covered by the latissimus dorsi in the latter position, only a small part of the muscle has to be divided and this is not a serious complication. In pneumococcal cases, that is to say the majority of cases of empyema in children, prolonged drainage is not necessary and in them it will often suffice to make the opening in the mid-axillary line. In adults however, where the infection is generally streptococcal, and in any case in children known to be of the same variety, it is best to employ the posterior opening. This is a point upon which bacteriological examination of the pus beforehand is of great value.

many cases, especially those of pneumococcal origin, the period required for drainage is so short that the question of regeneration of the rib is of no importance. On the other hand in cases due to streptococcal infection or in others in which the drainage is likely to be prolonged, regeneration may be prevented by clipping away the periosteum after the rib has been removed. The permanent loss of a portion of the rib seems to be of no consequence whatever to the patient, and the inflammation and necrosis of the ends of the bones exposed to the action of the pus which might be expected is almost unknown. We advise therefore that a portion of the rib should always be resected. The operation is generally done just as quickly, and in some cases more quickly, as there is less trouble with the bleeding, while the immediate investigation and clearing out of the cavity is much more satisfactorily accomplished.

After the surgeon has settled which rib to resect, the skin is steadied and put upon the stretch by the forefinger and thumb placed above and below that portion of the rib, and the knife is carried right down to the outer surface of the bone along its centre, dividing all the soft structures and periosteum in one cut for a distance of two or three inches. The knife may then be carried along the incision a second time to make sure that the periosteum is completely divided throughout and then the latter is rapidly peeled off the front of the rib with a suitable rugine. When the incision is a short one it may be convenient to make small vertical incisions through the periosteum at each end of the horizontal one and this enables the periosteum to be peeled off from the portion to be resected without stripping it up from the adjacent bone; but this is not a matter of any great importance. After the periosteum has been peeled off the front of the rib, a curved rugine is insinuated around its upper border taking great care not to puncture the pleural cavity. The instrument is made to work from the upper border to the lower and, when it emerges around this, it is pushed along the rib between the periosteum and the bone and so bares the posterior surface of the whole of the portion of the rib to be removed. The rugine is pushed to one end of the incision and held in position so as to keep back and protect the pleura, whilst the rib is nipped across with a pair of cutting pliers. The rugine is then slipped up to the opposite end of the incision and the bone there is divided in a similar manner; this procedure is facilitated by lifting up the end of the bone first divided and steadying it in a pair of sequestrum forceps. When the resected portion of the rib has been removed, the periosteum with the parietal pleura covering it is exposed between the divided ends of the rib and in the centre of this space a pair of sinus forceps is pushed in until the pus is reached. The blades of the forceps are expanded very gently at first so as to allow the pus to escape quite slowly. It is not advisable to make a free incision in the first instance as otherwise the pus gushes out and there may be alarming syncope from the sudden relief of pressure.

After the pressure has been thus gradually relieved and the pus simply ebbs and flows with respiration, the opening should be made just large enough for the finger to be introduced through it. It is most important that the condition of the pleural cavity should be investigated with the finger, as it is not uncommon to find large fibrinous masses which will plug the opening and prevent the escape of pus and which therefore require to be cleared out before the pus will flow freely; if left in the thoracic cavity they will no doubt break down and escape in fragments, but they will probably delay the closure of the wound considerably and therefore it is important to remove them all at the time of the operation. As a rule these masses can be brought to the surface with the finger, seized with forceps and pulled out; or they can be hooked out with a small spoon or a curved blunt instrument quite readily. Some surgeons strongly advocate washing out empyemata but we do not recommend this except in rare instances when the contents of the empyema are very foul. Immediate death has followed this practice, for reasons which are not at all clear, and we have found that washing out a cavity does not enable these masses to be removed any better than with the fingers or forceps aided by the expulsive action of the thorax as occurs when the child coughs. Another important point on which information may be obtained by digital investigation of the interior of the pleura is the condition of the lung.

The next question that arises is that of drainage. Here again the bacteriology is of importance. It has been pointed out by Dr. Sutherland¹ that in many cases in children drainage is not necessary provided that steps be taken to secure expansion of the lung at the time of the operation, and this appears to hold good for the cases due to the pneumococcus; in streptococcal infections, however, drainage must be resorted to as in the case of any acute abscess. In pneumococcal empyemata we have had excellent results by following Dr. Sutherland's suggestion, the essential point of which is to endeavour to obtain expansion of the lung as soon as possible when the finger in the cavity shows that it is not too firmly bound down by adhesions. This is best done by allowing the patient to partially awake from the anæsthetic, when the irritation caused by the finger introduced into the pleural cavity excites coughing. Every time this happens air is forced into the lung and leads to its expansion. At the moment the child coughs the finger is slightly withdrawn from the opening and allows a little of the pus to escape and then immediately plugs it again during inspiration. This prevents air getting back into the pleural cavity and the lung may often be made to expand completely by continuing in this way. If the lung expands fully at the time of the operation and the case is pneumococcal in its origin, it is unnecessary to introduce any drainage tube at all and it will be sufficient to lay a piece of protective about three inches square over the wound and outside this to apply a large ordinary antiseptic dressing. The protective acts as a valve, allowing the escape of

¹ See *Lancet*, Jan. 27 and June 9, 1894.

the discharge beneath it whenever the patient coughs, but falling back and blocking the opening during inspiration. In many of these cases the wound heals in a week or ten days without leaving disability of any kind.

When the lung does not expand fully, a drainage tube which merely projects into the pleural cavity will suffice in pneumococcal cases. No doubt when the finger is withdrawn and the drainage tube is introduced, air at once passes into the pleural cavity and the lung tends to collapse again, but the result of the manipulation above described is to get rid of the adhesions and, as soon as the air is expelled from the thorax, the lung expands again, provided that no more air is allowed to enter. This is guarded against by laying over the surface of the tube and the surrounding chest wall a piece of sterilised oiled silk protective which acts as a valve, so that fluid can easily be forced out beneath it when the patient coughs, but on the cessation of the cough the protective flaps against the orifice of the tube, plugs it and prevents the entrance of air. In a comparative short time, especially if the patient be encouraged to cough, the air sucked in after withdrawal of the finger is expelled and healing rapidly occurs.

A simple way of ascertaining the correct length of a drainage tube is to bend the tip of a probe at right angles and then insert it well into the pleural cavity and draw it back until the angle catches against the inner surface of the thoracic cavity. The surgeon can thus measure off the thickness of the thoracic wall from the skin to the parietal pleura and, if he cuts a drainage tube a quarter of an inch longer than this, it will suffice. No lateral holes should be made in the tube, but it is rather important to cut a semicircle out of one side of the end of the tube so as to prevent it being blocked when the lung expands and comes against it. Many special drainage tubes for empyemata have been introduced, and no doubt some form of tube provided with a shield to prevent it slipping into the chest is called for when prolonged drainage is necessary, but, in children at any rate, all that is required is to cut the tube flush with the skin and secure it in position by a couple of silkworm-gut stitches passing through the skin, as for drainage of abscesses in other parts of the body.

If it be found in the course of two or three days that the lung has completely expanded, that there is no active suppuration going on, and that the general symptoms have improved, the tube may be removed and the wound allowed to heal by granulation. During the first few dressings the protective may be continued, but in a short time adhesions will have formed between the lung and the parietal pleura around the tube, so that there is not the same tendency to the entrance of air and collapse of the lung when the protective is removed.

After-treatment.—The discharge is usually free for a few days, and the dressings will require changing two or three times daily. As the discharge diminishes, the change of dressing will be less frequent and in fact the case is treated very much like an ordinary abscess. The stitches fastening

in the drainage tube may be removed about the fifth day, and a tube provided either with flanges or with a safety-pin run across it to prevent it slipping into the thorax should be substituted; the pressure of the dressings outside will prevent the tube slipping out. No irrigation should be practised, as it is not only useless for the reasons we have already mentioned in dealing with acute abscess, but sudden death and serious collapse have been known to occur from it. The length of time the drainage tube should be continued varies greatly and depends largely upon the bacteriology of the case. In pneumococcal cases in children where there is no great fixity of the lung the rule is to keep on drainage as long as pus is discharged from the cavity, or at any rate as long as any is coughed out through the dressings. When the discharge has become serous the tube may be left out; even if distension of the pleura were to take place again, the discharge, being serous, might become absorbed. Godlee suggests that, under these circumstances, to prevent granulations blocking the opening, a grooved instrument should be introduced every two or three days so that any serum that has collected may be allowed to escape and, if this be done, the final closure of the cavity is much facilitated. Should the fluid thus escaping be found to be purulent and not serous, the tube should be re-introduced. The management of the tube in these cases is a matter of great difficulty and is really one of the most important points in the treatment. It is essential in all cases to maintain the strictest asepsis.

The patient should be kept in bed for a week or longer in all cases but, if at the end of that time the temperature be normal and the condition has improved, he may be allowed to sit up and get about; drainage will be more efficient when he is in the erect position. Suitable general treatment must be employed, and the patient should go to the seaside or the country if healing be not progressing rapidly enough, provided that he can be where he is sure of proper aseptic treatment.

(b) Of localised empyema.—Here the treatment follows similar lines, but the great difficulty is to find the pus, as the physical signs may be so indefinite when the collection is small that the surgeon can only expect to tap the abscess after repeated punctures. When however the pus has been found after a careful search, the needle is left in as a guide and a portion of the rib above it is resected, the pleura opened and the empyema evacuated. These cases are usually more favourable in their prognosis because the lung is not bound down in the same way; indeed it is frequently adherent to the parietes.

(c) Of double empyema.—This is a serious condition, as the respiration on both sides is embarrassed and it is hardly safe to open both pleural cavities simultaneously for fear of causing still further trouble. The best plan is to open one side and to leave the other for a few days until the patient has become accustomed to the new condition of affairs. If the respiration be very embarrassed, some of the pus may be drawn

off from the opposite side by an aspirator, but simultaneous opening of both pleural cavities should certainly be avoided if possible.

(d) **Of an empyema that has ruptured into a bronchus.**—In these cases it is probably best to wait for a little time to see if the cavity is thoroughly evacuated through the bronchial tubes or not. Should the evacuation not be satisfactory, the empyema must be opened from the outside and drained, but under these circumstances closure of the wound is often very long delayed and sometimes does not occur; however the patient is saved from the dangers of the pus continuing to discharge through the bronchi and usually only a small sinus is left.

(e) **Of an empyema that has failed to heal.**—The length of time that an empyema requires for closure after incision and drainage varies greatly, the chief element being the expansion of the lung. When this is incomplete, a cavity is left which takes some considerable time to close, but closure eventually occurs in most cases and is aided by a certain amount of falling-in of the chest wall and displacement of the various intra-thoracic structures, such as the diaphragm, the contents of the mediastinum, etc., which is largely brought about by the contraction of the granulation tissue lining the portion of the cavity remaining.

In some cases however the lung is so bound down that, after allowing for all these factors to come into play as much as possible, a large cavity remains and the surgeon is confronted with a very serious state of affairs which is all the more likely to be met with when the empyema had existed a long time before the pleura was incised and drained. Another cause of failure in the closure of an empyema is tuberculosis. In tuberculous empyema operation is not satisfactory and should be avoided if possible because the cavity is not likely to close (see p. 537). Among the minor causes of failure are imperfect drainage, such as occurs when the opening is too high up in the chest; this is easily rectified and closure will follow. It is also supposed that the use of a drainage tube projecting too far into the chest may lead to the formation of a sinus, although this is a matter of doubt. Finally, if a portion of rib has undergone necrosis, a discharging sinus will remain, but here the pleural cavity may close and the sinus may be merely an external one.

The chief factors in the non-closure of an empyema are therefore imperfect expansion of the lung, imperfect drainage or a tuberculous condition of the pleura. When an empyema has lasted for a long time there is generally considerable sepsis present and as a result waxy degeneration of the viscera takes place and the patient gradually goes downhill and ultimately dies exhausted; therefore, when it is evident that closure of the cavity is not likely to occur, it is highly important to take steps to effect it.

In any case of empyema that has lasted for more than six or eight weeks and in which a cavity remains, the surgeon should make sure in the first instance that the condition is not due to imperfect drainage. If

the opening has originally been made in the mid-axillary line and if it be found that a probe passed into the cavity goes readily downwards to a lower spot where pus can collect, a counter-opening should be made in that situation. The original opening should also be dilated, and it is a good plan to pass a drainage tube perforated laterally in a number of places from one opening to the other. This may be stitched to the skin at both openings, but after about five days the sutures may be cut and the tube withdrawn, cleaned and re-inserted. When the tube is withdrawn for cleaning it is well to attach a long piece of silk to one end of it and then to withdraw it from the other end, so that the silk thread is drawn through the pleura and serves to pull the tube back in position after it has been cleansed. In about a week or ten days the tube may be shortened, the upper end being cut so that it no longer projects through the upper aperture, and in this way the sinus is gradually got to close.

The cases in which there is imperfect expansion of the lung are much more serious. Here a cavity is left and, after the diaphragm and other soft structures have yielded as far as possible, the only possibility of its closing is the eventual falling-in of the thoracic wall. This is an extremely slow process and is generally imperfect, and in the meanwhile the patient gradually goes downhill from the continued sepsis. If therefore closure be still defective after four or six months in spite of perfect drainage and good hygienic conditions, some operative interference must be undertaken. There are two methods at the disposal of the surgeon 1. The operation of thoracoplasty or Estländer's operation, in which the ribs forming the outer wall of the cavity to be obliterated are removed bodily; and 2. Decortication, in which the thickened pleura, or at any rate the dense fibrous outer layer of it, is peeled off the lung so as to allow it to expand once more. The operation in common use at present is that of thoracoplasty. This is often a severe and difficult operation and does not always succeed, but it is absolutely necessary when a prolonged trial of other methods has failed and also when the case is due to tuberculosis.

1. Thoracoplasty.—The first step in the operation is to open up the sinus, insert the finger and ascertain exactly the limits of the cavity left. These are carefully marked out on the chest wall and the portions of the ribs lying in the space thus marked out require to be removed. If the cavity be small, possibly only two or three ribs will require this treatment, but with large cavities portions of several ribs have to be taken away. The method of exposing the ribs will depend upon circumstances, but as a rule it is best done by a flap which is so marked out as to expose the whole extent of the cavity. No precise rules can be given for the formation of this flap as it must depend on the conditions present. Probably the one that will least interfere with the muscles, etc., will be a flap with its convexity forwards and downwards. The flap must be larger than the cavity

beneath it so as to give plenty of room, and it should take everything off the thoracic wall except the intercostal muscles, so that it may include the pectorals and the serratus magnus. When the flap is raised the bleeding points should be secured before going further.

The finger is now introduced into the cavity and the exact extent of each rib that requires removal is ascertained. The periosteum over each is then incised and separated from the rib and the desired portion is removed exactly as for opening an empyema (see p. 530). The amount of each rib requiring resection will vary according to the irregularity of the cavity beneath. In bad cases this removal may have to extend quite high up, but it is never advisable to remove any portion of the first rib and it is doubtful how far removal of the second rib is beneficial; the required amount however of all the other ribs should be removed without hesitation. It is possible that the patient's condition may be so bad that it may not be safe to remove all the necessary ribs at one operation and in this case it will be better to attempt to obtain closure of one part of the cavity and leave the remainder for a second operation.

After having removed the necessary portions of rib sub-periosteally in this manner, the next important step is to remove the whole of the periosteum and thickened pleura forming the outer wall of the cavity; these may be cut away with scissors in one piece. The incision should be commenced posteriorly so that the intercostal vessels may be caught behind as they are divided and thus the bleeding will be less. As a matter of fact there is generally very slight hæmorrhage, as the intercostal vessels are often partially or entirely obliterated by the great thickening that is present. There is in any case no difficulty in arresting the bleeding as there is plenty of room to seize the vessels, provided that the ribs be excised sub-periosteally and separately in the manner above described before any attempt is made to remove the pleura.

After the pleura and periosteum have been removed, a cavity is left, the floor of which is formed by the thickened visceral pleura covering the collapsed lung. This cavity is now cleaned as thoroughly as possible and, if thought desirable, the granulation tissue upon it is scraped away with a sharp spoon, although this is not essential. Decortication (see p. 537) may now be carried out if desired, but this is not an essential part of Estländer's operation, the object of which is to allow the soft parts to fall into contact with the collapsed lung rather than to promote the expansion of that organ.

The flap of soft parts is now laid back in position and, if a sufficient amount of the thoracic parietes has been taken away, the flap will come into contact with the visceral pleura everywhere. It is well however to insert one or two moderate-sized drainage tubes at the most dependent spot beneath the flap so as to provide drainage, as these cases are generally septic.

The results of this operation are extremely variable. In small cavities,

especially those which do not extend far up the chest, the success is generally striking. In others, however, even the most extensive operation gives disappointing results. Considerable improvement generally occurs however for, even though the cure may not be complete, the main part of the cavity becomes obliterated and only a comparatively small sinus is left, generally at the upper part where closure is most difficult to obtain, and from this only slight discharge comes which does not do the patient much harm.

2. Decortication.—In view of the very unsatisfactory results that follow Estländer's operation when performed for very bad cases, the suggestion has been made that the lung should be decorticated, that is to say, that the dense, fibrous layer of the pleura which covers it and binds it down into the vertebral groove should be peeled off so as to allow the lung to expand. We have followed this recommendation with success in more than one case where a previous Estländer's operation had failed. The steps of the operation are practically identical with those of thoracoplasty in the early stages, and indeed the operation may be looked upon merely as an addition to that operation, its object being to set the lung free to expand and so to meet the flap of soft parts halfway.

After the cavity has been exposed by the removal of the thoracic parietes, the dense layer of the visceral pleura covering the lung is divided with the knife until the lung tissue is met with; the edge of the incision is then seized in forceps and stripped off the lung with a blunt instrument as far back as the edge of the vertebral groove. When this has been done it is striking to see how the lung at once expands. As a rule there is only moderate oozing. It is advisable that the separation of the visceral pleura should be effected slowly, as collapse of the lung, which was previously prevented by the dense adhesions, may occur during it and would result in serious embarrassment to respiration. The operation is finished by putting in a drainage tube and suturing the cutaneous flap as before.

(f) Of tuberculous empyema.—The symptoms associated with tuberculous empyema are indefinite, and the condition may only be discovered when the physician comes to examine the chest. It may occur with or without pneumothorax. In the former case there will probably be an acute onset corresponding to the perforation of a cavity into the pleura. When no such perforation occurs however, the symptoms may be quite insignificant and little or no pressure may be exerted; the patient simply goes about with a collection of fluid in the chest which, although not under great pressure, leads to collapse of the lung.

The cases are very unsatisfactory. As a matter of experience it is found that evacuation and drainage does not lead to rapid healing; the lung fails to expand, the chest takes a long time to fall in and, even with the greatest care, sepsis is prone to occur and then, in addition to the tuberculous empyema, the patient will suffer from a septic cavity and will

go downhill rapidly. Hence, if the diagnosis of a tuberculous empyema can be made with certainty, it is better to avoid anything like a free incision; indeed in cases not marked by pressure symptoms it may be inadvisable to interfere at all, and, if anything must be done, it should take the form of occasional partial aspiration rather than free opening. The greatest care must be taken with the aseptic management of the case, lest a simple tuberculous empyema be transformed into a septic one.

PYO-PNEUMO-THORAX.—Cases of simple pneumo-thorax commonly follow injury and these are dealt with separately (see p. 518); this condition may be followed by suppuration, when a septic pyo-pneumo-thorax occurs. Most cases of pyo-pneumo-thorax however are due to the perforation of a tuberculous cavity, with the free passage of air from the bronchus into the pleural cavity followed by suppuration.

Treatment.—Cases of tuberculous pyo-pneumo-thorax in which the ordinary pyogenic bacteria are absent may occur however, and they are then very chronic and do not cause severe symptoms. Should this be so, it is better to leave the case alone, as the results of incision are bad and the improvement is only temporary. The patient soon goes downhill as it is very difficult to prevent the entrance of septic organisms and there is practically no chance of the lung expanding sufficiently to fill the cavity; moreover, the patient is too bad for any operation such as Estländer's.

If however the symptoms be severe, the chest should be aspirated and this should be repeated from time to time if necessary. Should this fail to produce amelioration, Godlee suggests the employment of syphoning and describes the following plan:

The patient is placed on his back with his side projecting slightly beyond the edge of the bed, and two perforated needles are introduced into the chest about the eighth or ninth interspace, one towards the anterior and one towards the posterior part of the chest. It should be ascertained that the lung is not adherent at the points selected for the introduction of the needles. To each needle is attached an india-rubber tube; that in connection with the anterior one passes to the bottom of a large bottle containing warm boracic acid lotion, while an aspirator is connected with the other or it is simply allowed to fall into a basin which is placed on the floor and which contains enough boracic lotion to cover the end of the tube. The fluid is thus allowed to drain from the chest and its place is taken by the boric acid solution. When the solution comes through quite clear, the anterior tube is removed, as much as possible of the boric acid solution is evacuated by the aspirator or by the syphon action, care being taken to avoid the entry of air, and then the wound is closed. This procedure may be repeated from time to time according as may be necessary.

SEPTIC MEDIASTINITIS.—When a penetrating wound of the anterior mediastinum does not lead to immediate death from hæmorrhage

it is apt to be followed by septic inflammation and the formation of an abscess in the anterior mediastinum. This may also follow sepsis in the neck, such as Ludwig's angina, tracheotomy, or operations upon the thyroid or cervical glands in which sepsis has occurred; it is a not infrequent accompaniment of the impaction of foreign bodies in the œsophagus, which becomes perforated. The chronic form of abscess is not uncommon in connection with tuberculous disease of the sternum or costal cartilages, and occasionally with a similar affection of the mediastinal glands. It may occur occasionally as a primary disease in cases of general sepsis.

Symptoms.—*In acute cases* there is great pain, severe cough, high fever, dyspnoea and all the other symptoms of septic inflammation. *In chronic cases*, the symptoms are less severe and are difficult to distinguish from those of tumour of the mediastinum. There will be dysphagia, dyspnoea, occasional asthmatic attacks, lividity, and irregularity of the heart's rhythm. If the patient survives, and especially in chronic cases, the pus may find its way beside the sternum and point between the costal cartilages. In other cases the abscess may open into the bronchi and may be expectorated, or it may perforate the pleura and set up a pyo-thorax, or the pericardium and give rise to suppurative pericarditis.

The *prognosis* is very serious and the chances of recovery are very slight in acute mediastinal suppuration, the patient dying of pyæmia or perforation of the pericardium or pleura, if he does not die of acute septicæmia or of the pressure effects. In chronic cases however the abscess frequently finds its way externally and, if it be opened, the symptoms will be relieved; if the disease be connected with caries of the sternum, removal of the involved portion of bone may be practised and the patient may get well.

Treatment.—This is a matter of extreme difficulty. If a collection of pus in the anterior mediastinum can be accurately diagnosed it is possible to get at it by trephining the sternum and enlarging the opening so as to tap the abscess and provide for drainage; this has been done successfully in a few cases. Should an abscess occur in the posterior mediastinum in connection with perforation of the œsophagus by a foreign body, the abscess may be reached from behind by the operation already described (see Part VI., Sec. I., p. 105). In tuberculous abscess the treatment is similar but it is easier and more likely to be successful.

CHAPTER LV.

THE INFLAMMATORY AFFECTIONS OF THE LUNGS AMENABLE TO SURGICAL TREATMENT.

THIS subject is still in its infancy and is full of difficulty; its full discussion really involves the medical aspects of the cases as well. We must therefore refer the reader to some special work upon the subject¹ for the points that are omitted here.

THE TREATMENT OF PULMONARY CAVITIES.

This may be called for under the following conditions: 1. Abscess of the lung following pneumonia; 2. Bronchiectatic cavities; 3. Tuberculous vomicae; 4. Chronic non-tuberculous lung cavities; 5. Abscesses due to foreign bodies in the lung or the smaller bronchi.

ACUTE ABSCESS FOLLOWING PNEUMONIA.—An abscess of this kind is often accompanied by gangrene of the lung and should always be drained from outside unless it bursts into the bronchus and is completely evacuated by that route. Whenever a pneumonic abscess bursts into the bronchus it is well to wait for a few days and see whether the condition improves. Should it fail to do so, surgical interference becomes urgent, as otherwise the patient will go downhill as a result of the insufficient drainage and the burrowing of the abscess in various directions in the lung.

These abscesses are often multiple and their localisation is extremely difficult, owing to the consolidation of the lung that is present. The patient expectorates sputum containing gangrenous lung tissue of an offensive odour, which is so exceedingly typical that it can hardly be mistaken. As to the exact localisation of the abscess medical text-books

¹ Such for instance as *Diseases of the Lungs* by J. K. Fowler and R. J. Godlee: Longmans, Green & Co., London, 1898, from which most of the following points are taken.

should be consulted. As far as the surgeon is concerned, he attempts to find the pus by means of an aspirator after the approximate situation of the abscess has been ascertained. The operation should never be begun until the pus has been actually localised by aspiration.

Aspiration for the localisation of a pulmonary abscess should be performed upon the operating table after all arrangements have been made for proceeding to incise and drain the cavity when it is found. The patient should not be under an anæsthetic and the operation is performed much in the same manner as for abscess of the liver (see p. 116). It is often exceedingly difficult to localise the abscess, a number of punctures may be necessary and no doubt there is a considerable risk of infecting the pleura during the search. When the pus has been found only a few drops should be drawn off, and the needle is left *in situ* as a guide and is at once taken charge of by an assistant who prevents it being displaced whilst the patient is being anæsthetised. The assistant must in fact devote his whole attention to steadying the needle for, were it to slip out of position, not only would there be a great risk of the pleura becoming infected, but the difficulties of the operation would be enormously increased.

Incision and drainage.—Only partial chloroform anæsthesia should be induced and, after the skin incision has been made, the administration is entirely suspended until the pleura has been reached, because there is a considerable risk of suffocation from the contents of the abscess finding their way into the air-passages; ether should not be employed because of the copious bronchial secretion to which it gives rise. The patient should lie flat upon the back upon the table and should have the affected side drawn well beyond the edge, or else he should lie upon the affected side itself as for the opening of an empyema (see p. 529). Free space is required for the proper manipulations and therefore an inch and a half or two inches of the ribs immediately above and below the space in which the needle lies should be resected in the ordinary manner.

The first point is to ascertain whether the visceral and parietal layers of the pleura are adherent; if this be so, an incision can be made alongside the needle without any fear of collapse of the lung occurring. If however there be no adhesions, the visceral and parietal pleura must be stitched together by a circle of catgut sutures inserted upon fully-curved needles of considerable size going a fair depth into the lung and arranged in a circle at least an inch or an inch and a half in diameter so as to leave as large an area for manipulation as possible.¹ All this must be

¹ The simplest way of securing an air- and water-tight approximation of the two layers of the pleura is to unite them by a series of locked stitches inserted in the same way as in needlework. The needle is inserted and brought out and the second insertion is made midway between the points of insertion and emergence of the first. The third insertion is made midway between the points of insertion and emergence of the second stitch, *i.e.* close to the point of emergence of the first, and so on. There is thus practically a double layer of stitches all round the circle.

done before the pleura is opened, as otherwise the lung may collapse and cannot be reached. Should such an accident happen, the operation must be given up temporarily until the air in the pleural cavity has become absorbed; as a rule however the lung is consolidated in cases of pulmonary abscess and does not fall away from the chest to any material extent. A second row of stitches may be inserted outside the first so as to make the connection between the two layers of the pleura still more safe.

When the layers of the pleura have been thus fastened together so that there is no possibility of leakage occurring between them,—which is generally indicated by the absence of sucking-in of air,—the further steps of the operation are proceeded with. Should it be found that air is sucked in at any spot, more stitches should be inserted there. The abscess is opened by passing a long pair of sinus forceps alongside the needle until the pus begins to flow, when the needle is withdrawn and the pus is carefully mopped up as it emerges. The opening in the lung should be kept quite small until most of the pus has escaped and should then be increased by separating the blades until the finger can be introduced into the cavity which is then carefully explored. The cavity should on no account be washed out, for not only does this do no good but the fluid may readily find its way into the bronchus and cause asphyxia. A mixture of equal parts of iodoform and boracic acid may be blown into the cavity with an insufflator after the wound has been swabbed out with chloride of zinc (40 grs. to the oz.). The largest sized drainage tube is then introduced into the cavity and is packed fairly firmly around with iodoformed gauze; the tube should only have holes in the portion that lies in the abscess cavity and should in every case be large enough to exert sufficient pressure upon the lung tissue surrounding it to check oozing. The wound is left open and a large dressing is applied.

After-treatment.—The tube is left *in situ* for two or three days until its track is well established, when it may be removed, washed and replaced; it should be prevented from slipping into the thorax by passing a safety-pin through its outer end. The abscess cavity should never be washed out; insufflation of iodoform and boracic powder may be practised at each dressing and the tube should be retained until the discharge is mucoid in character and all expectoration has ceased.

The prognosis is very bad, but a certain number of cases may be expected to yield a good result when the condition is dealt with early and the abscess is confined to one lung or one lobe of a lung. Cases of gangrene and collapse of the lung due either to the pressure of an intra-thoracic tumour or to the escape of septic discharges into the air passages, as for example after cut-throat or tracheotomy, are beyond the reach of surgical drainage and should be left alone; even simple exploration with a hypodermic needle may give rise to an acute empyema in these cases.

BRONCHIECTATIC CAVITIES.—The great difficulty here is to open the cavity at its most dependent spot, as a number of cavities often communicate and the drainage of one does not necessarily imply the free drainage of others. Unless therefore the symptoms point to the presence of one large cavity, surgical intervention is of very little value as it will generally be found that, although the patient improves for a time and the fœtid expectoration is much relieved, fresh collection occurs subsequently and the symptoms recur.

The steps of the operation are similar to those already described (see p. 541). According to Godlee there is rarely any adhesion of the pleura, and therefore it is most important to suture the two layers together before the pleural cavity is opened, as otherwise the lung collapses and cannot be got at. Should this accident happen, the wound in the pleura must be closed and the patient must be left for the air to be absorbed before the operation can be proceeded with.

When the bronchiectatic cavity is opened, it presents a characteristic feel to the finger, being smooth, firm and usually globular, whereas an abscess cavity is irregular, spongy and friable. Its contents are sticky muco-pus, usually copious and not always offensive.

The *after-treatment* is similar to that for pulmonary abscess (see p. 542). Should the patient derive no benefit, the tube should be removed, when the external opening will probably close and the patient will be left much in the condition in which he was before operation.

TUBERCULOUS CAVITIES.—Hitherto surgical interference has not been much employed in these cases and, when it has been carried out, it has not met with any particular success. This is partly due to the fact that on the one hand, when the cavity is sufficiently small and localised to render surgical measures likely to be of value, the case is in a stage at which a cure by medical measures is most to be expected; whereas, when the patient suffers from distressing symptoms due to a cavity, the mischief is so far advanced that surgical measures are little likely to be of value.

If the operation is undertaken its steps are similar to those described for pulmonary abscess (see p. 541).

CHRONIC NON-TUBERCULOUS CAVITIES.—These are the most suitable cases for surgical interference, but they are only very occasionally met with in practice. When they occur they are usually due to abscesses that have formed elsewhere and have ruptured into the lung, the typical example being an abscess of the liver. It is obvious that if the abscess can be diagnosed and localised and the surgeon is able to drain it, the chances of recovery are exceptionally good, as the rest of the lung is healthy and drainage of the abscess may be carried out at its most dependent spot. The principles of treatment and after-treatment are exactly similar to those for pneumonic abscess (see p. 541).

CAVITIES DUE TO FOREIGN BODIES LODGED IN THE BRONCHUS.—As a rule the foreign body becomes impacted near the

bifurcation of the trachea and may be reached by a low tracheotomy wound, and these cases have already been dealt with (see Part V., p. 246). The foreign body impacted in the bronchus may give rise to pneumonia, dilatation of the bronchi behind it, breaking down of the lung and the formation of a burrowing abscess which may extend to the pleura and give rise to an empyema or may cause it to adhere to the thoracic wall and burst externally. When the foreign body is small and lodged deep in the substance of the lung, it may give rise either to an abscess in the lung tissue or else to a localised empyema.

The treatment of a foreign body impacted in one of the larger bronchi has already been given (see Part V., p. 246). When the nature of the foreign body is such that it casts a shadow with the X-rays, a skiagram will greatly facilitate its localisation. Should it turn out that the body is imbedded in the lung substance, the surgeon may be called upon to explore that organ, which he will do in the manner already described for an abscess of the lung. Should he have to open an empyema from this cause, he will probably find on introducing the finger that, instead of feeling the smooth external surface of the lung covered by the thickened pleura, his finger goes into a ragged cavity which is obviously broken-down lung tissue; careful probing may reveal a sinus leading in the direction of the bronchi, and may indeed actually detect the foreign body. If this be so, the opening in the chest wall must be enlarged, when the foreign body can probably be extracted by suitable forceps. If it is not thus detected and extracted, it may possibly find its way along the track left for drainage, which should always be of the largest possible dimensions.

The *after-treatment* is similar to that for the other forms of lung abscess (see p. 542) but, although the immediate results may be very satisfactory and the constitutional symptoms may rapidly disappear and the discharge lose its purulent character, the final results are by no means always good, as a sinus discharging thin muco-pus may remain practically indefinitely.¹

Conclusions.—Godlee (*op. cit.*) draws the following conclusions:

1. Gangrenous cavities of the lung should always be opened if possible;
2. So also should abscesses finding their way into the lung from elsewhere;
3. The same remark applies to abscesses due to foreign bodies; after an abscess of this kind has been opened, the foreign body may be extracted

¹ We have had one very interesting case in which a boot-button was extracted through the chest wall after incision of an empyema which communicated directly with an abscess of the lung; through this track the foreign body was felt with a probe and withdrawn. The abscess cavity rapidly contracted, but a sinus has persisted up to the present and has now existed for several years in spite of plastic operations and various other measures designed to obtain closure. The boy has however not suffered in any way from the persistence of the discharge, beyond the inconvenience of having to have it dressed repeatedly. He has no signs of lardaceous disease and the only trouble is a small sinus which communicates directly with the left bronchus and discharges a thin mucoid fluid but practically no pus (see *King's College Hospital Reports*, Vol. II., p. 97).

with forceps either through the wound in the lung or through a tracheotomy wound. 4. Single bronchiectatic cavities may be cured by operation. In multiple ones however, which is the common condition, the prognosis is not good and the case should only be treated by drainage if the lung be adherent to the chest wall. 5. Basic tuberculous cavities may be similarly treated, but apical ones should never be opened except for harassing cough. The operation here is not curative and the cavity will require treatment afterwards by injections either through the larynx or through the chest wall.

CHAPTER LVI.

PERICARDITIS: PULMONARY ACTINOMYCOSIS: NEW GROWTHS OF THE THORAX.

PERICARDITIS.

THIS may be simple or suppurative, acute or chronic, and is a medical question except in so far as the removal of the fluid is concerned. In simple serous pericarditis the embarrassment of the heart's action may be so great that paracentesis pericardii may be required.

Paracentesis of the pericardium.—This is performed by inserting an aspirating or large exploring needle an inch to the left of the margin of the sternum in the fifth intercostal space. This point is chosen so as to avoid the internal mammary artery and it will also avoid the pleura if the pericardium be distended. The greatest care must be taken with the aseptic precautions, and it is well to divide the skin with a knife as a preliminary measure, so as not to have to thrust the needle violently through it. The needle should be passed in slowly and steadily, and the aspirating bottle should be attached to it during its progress, so as to show at once when the fluid begins to escape; a sudden thrust might injure the heart. The small puncture is closed by a collodion dressing.

For purulent pericarditis, however, incision and drainage of the pericardium are required.

Drainage of the pericardium.—This is usually effected through an incision in the fourth or fifth left intercostal space, but better room is obtained if a portion of the fifth costal cartilage be excised. An incision should be made over the whole length of the fifth costal cartilage¹ and particular

¹ Mr. Herbert Allingham has suggested that the pericardium should be approached from the lowest point between the xiphoid cartilage and the costal cartilages, and in the *Lancet* for March 21st, 1903, a case is recorded in which Mr. Pendlebury operated successfully in this way. He describes the operation as follows:

“A vertical incision some four-and-a-half inches long was made with its centre at the lower border of the seventh costal cartilage parallel with, and one inch from, the

care must be taken in separating it from the surrounding structures not to wound the internal mammary artery. After the cartilage has been removed, the pleura which overlaps the pericardium externally should be looked for and pushed aside. The pericardium is identified and seized close to the left border of the sternum and an incision is made in it obliquely downwards and outwards from the edge of that bone. After the pus has escaped, a drainage tube is inserted in the ordinary way, care being taken to see that it does not project into the pericardium further than is necessary to secure drainage, lest injurious pressure be exerted upon the heart.

PULMONARY ACTINOMYCOSIS.

This is a rare affection of the lungs and pleura, probably resulting from the inhalation of the fungus. In the early stages the symptoms are quite obscure, but, as the disease spreads from the lung to the pleura and the pleura to the chest wall, the probability of accurately diagnosing the condition increases. It may be recognised comparatively early by the expectoration of the characteristic fungus. In other cases it may not be recognised until the chest wall has become involved and sinuses have formed, giving rise to the characteristic discharge. Occasionally it appears to commence in connection with the pleura and thoracic wall rather than with the lung.

Treatment.—These cases have been treated with more or less success partly by the administration of large doses of iodide of potassium but mainly by opening up the mass and scraping it away as completely as possible with a blunt spoon. These masses seem to be extremely vascular and there may be much difficulty with hæmorrhage, so that the surgeon may have to plug the cavity firmly in order to arrest it. Repeated scrapings will probably be necessary before the disease is cured.

HYDATIDS OF THE LUNG AND PLEURA.

This condition is uncommon and may be primary or secondary to the bursting of a hydatid of the liver through the diaphragm into the pleural cavity, and the patient may present himself not only with a hydatid of the pleura but also with one of the liver. Surgical experience

left border of the sternum. The skin and fascia were reflected inwards and outwards and the abdominal muscles were then detached from the seventh costal cartilage. The cellular interval, 'costo-xiphoid space,' containing the superior epigastric artery was then broken into, some of the muscular fibres of the diaphragm being torn. As the pericardium was distended it was easily brought into view, but, as Mr. Pendlebury wished to have sufficient room to insert the fingers after opening it, two inches of the seventh costal cartilage were removed." The internal mammary arteries were exposed and held aside and subsequently a portion of the sixth costal cartilage was also taken away so as to give the surgeon room to introduce his finger into the cavity.

of this affection is comparatively slight in this country but Australian surgeons report comparatively favourably of these cases.

Treatment.—After the presence and situation of the hydatid has been made out, portions of one or more ribs should be removed in a suitable position and the further procedures will depend upon whether the hydatid cyst is adherent to the parietal pleura or not. If it be adherent, it is only necessary to incise the cyst and allow its contents to escape, after which efficient drainage is provided. If however there be no adhesion to the parietal pleura, the subsequent steps will be similar to those for opening an abscess of the lung or a bronchiectatic cavity (see p. 541); that is to say, the pleura must be carefully stitched to the lung before the cyst is opened. No washing-out of the cyst should be adopted.

Good results have been obtained by simple puncture of the hydatid, but cases are known in which a fatal result has followed this procedure, the bronchi being flooded with the hydatid fluid. On the whole, treatment on lines similar to that for hydatid of the liver (see Chap. XIII.) is preferable.

NEW GROWTHS OF THE THORAX.

Tumours outside the thorax are of course treated on lines similar to those for tumours of soft parts elsewhere. Tumours of the lung are practically not amenable to surgical treatment and the only ones therefore which we need consider here are those in connection with the thoracic wall, particularly the ribs.

TUMOURS OF THE RIBS.—These may be simple, such as exostoses or enchondromata, or malignant, the latter being either sarcomata or carcinomata. Extensive enchondromatous and sarcomatous tumours of the chest wall have been successfully removed, but it is a question whether it is ever worth while to attempt the removal of carcinomatous masses from this situation as these are generally secondary to scirrhus of the breast and the condition is most unfavourable. For our own part we do not advise operation under these conditions, although portions of the ribs so affected have been removed with partial success.

In connection with the removal of tumours of the ribs, two points require consideration, in the first place the method of covering the wound subsequently, and in the second place the treatment of the pneumo-thorax that is likely to be produced. In removing these tumours it is absolutely essential that the wound should be closed afterwards and, if the case be one of sarcoma in which the skin is becoming involved over a considerable area and this closure cannot be effected, the operation may be considered strongly contra-indicated. Even if the wound could be closed by flaps, the operation is of very doubtful value because a pneumo-thorax must necessarily be induced and, if the external wound cannot be closely sutured, the air in the pleural cavity does not become absorbed and permanent collapse of the lung may ensue. Hence we would lay it down

as an axiom that these tumours should only be removed when it is possible to turn aside a flap and replace it after the removal of the growth.

The treatment of the pneumo-thorax does not present much difficulty. In the earlier operations, when sepsis was frequent, a fatal result generally occurred from septic empyema, and therefore strenuous efforts were made to maintain the pleura intact. Although this may be done successfully when the case is one of enchondroma, it should not be attempted when the tumour is sarcomatous in nature, and the surgeon must be prepared to remove the parietal pleura freely if necessary and so provoke a pneumo-thorax.

The operation consists in turning aside a suitable flap so as to expose the whole of the tumour, which is well defined and cleared; the ribs should then be exposed all round it at the point where they will require division. The periosteum is peeled off, the ribs are resected in the usual manner and for convenience in working it is well to take out about half an inch of the rib all round so that, before there is any risk of opening the pleura, the tumour is isolated from the chest wall and is merely attached by the pleura and intercostal muscles. It now only remains to divide these structures. The pleura should be first opened by a very small puncture and a sponge wrung out of salt solution, so as to avoid irritation of the pleura with a strong antiseptic, should be placed over the opening and air gradually allowed to enter the thorax. The chief risk in inducing a pneumo-thorax is the sudden entry of air. If this be effected very gradually and the operation be suspended until a condition of equilibrium has been restored, the risks are comparatively slight. When the air has gradually filled up the thoracic cavity the surgeon can safely proceed to clip away the tumour with its attached portion of thoracic wall and pleura, the assistant meanwhile clamping each intercostal vessel as it is divided. Cloths wrung out of hot salt solution are thrown over the opening should it be found that the operation will have to be prolonged owing to adhesion of the tumour to the diaphragm or any other structure; of course should the surgeon have reason to believe before operation that these adhesions exist he would not attempt to remove the tumour.

When the tumour has been removed and the bleeding arrested, the skin flaps are tightly sutured, the air in the pleura soon becomes absorbed and the lung resumes its functions. Appropriate remedies may be needed to meet the severe shock that such an extensive operation will entail (see Part I., p. 139).

Nothing need be said concerning tumours of the lung itself. Portions of the organ have been excised in tuberculous disease and it has been suggested that a similar procedure should be adopted for tumour, but the results are not encouraging and at present the operation can hardly be said to be a recognised procedure in surgery.

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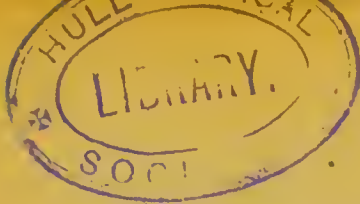
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